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APPLICANT : CANON INC;

INVENTOR : TSUKAMOTO TAKEO;

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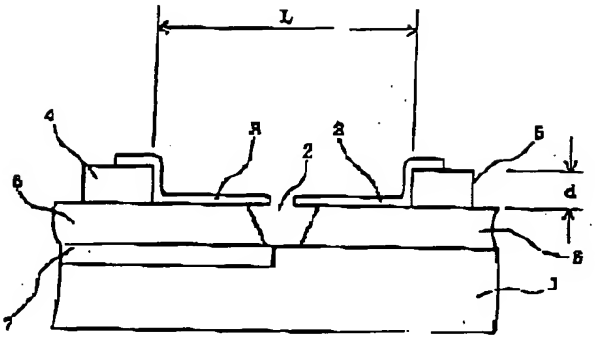
TITLE : ELECTRON EMITTING ELEMENT, ELECTRON SOURCE USING IT, AND IMAGE FORMING DEVICE AND THOSE MANUFACTURE



ABSTRACT : PROBLEM TO BE SOLVED: To provide an electron emitting element equal in electron emitting characteristic, being used suitably as the electron beam source of a image forming device, etc.

SOLUTION: In an electron emitting element which has a conductive film 3 where an electron emitting part 2 is made, between element electrodes 4 and 5, a piezoelectric layer 6 and an electrode 7 for piezoelectric substance are made on one side at least of the conductive films 3, with the electron emitting part 2 as a border. Hereby, the crack shape of the electron emitting part 2 can be controlled, and the electron emitting characteristic can be controlled, by controlling the voltage applied to the piezoelectric layer 6.

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(71)出願人　000001007
キヤノン株式会社
東京都大田区下丸子３丁目30番２号

(72)発明者　塚本　健夫
東京都大田区下丸子３丁目30番２号　キヤノン株式会社内

(74)代理人　弁理士　豊田　善雄　（外１名）

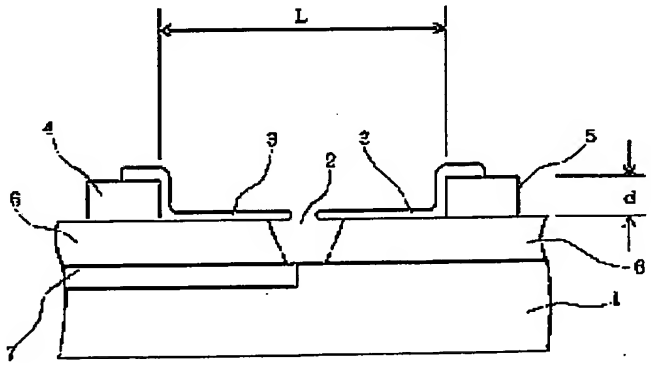
(54)【発明の名称】　電子放出素子、それを用いた電子源並びに画像形成装置と、それらの製造方法

(57)【要約】

【課題】　画像形成装置等の電子ビーム源として好適に用いられ、電子放出特性の均一な電子放出素子を得る。

【解決手段】　素子電極４、５間に、電子放出部２が形成された導電性膜３を有する電子放出素子において、導電性膜３のうち電子放出部２を挟として少なくとも一方の側に、圧電体層６と圧電体用電極７を形成する。

【効果】　圧電体層６に印加する電圧を制御することで、電子放出部２の亀裂形状を制御でき、電子放出特性を制御できる。



1

【特許請求の範囲】

【請求項１】　素子電極間に、電子放出部が形成された導電性膜を有する電子放出素子において、

前記電子放出部を境として、前記導電性膜のうち少なくとも一方の側に、圧電体層と圧電体用電極が形成されていることを特徴とする電子放出素子。

【請求項２】　前記電子放出素子は、表面伝導型電子放出素子であることを特徴とする請求項１に記載の電子放出素子。

【請求項３】　請求項１又は２に記載の電子放出素子の製造に際し、前記素子電極間に電圧を印加して該素子に流れる素子電流と該素子から放出される放出電流を検出し、該検出結果に基づき前記圧電体層に印加する電圧を制御して該圧電体層に逆圧電効果により発生する歪み量を制御することで、前記電子放出部の亀裂の幅を制御して、前記素子電流及び放出電流についての素子特性を制御する工程を有することを特徴とする電子放出素子の製造方法。

【請求項４】　請求項１又は２に記載の電子放出素子と該電子放出素子の駆動手段とを有することを特徴とする電子源。

【請求項５】　前記電子源は、複数の電子放出素子が並列に結線された素子列を少なくとも１列以上有する電子源であることを特徴とする請求項４に記載の電子源。

【請求項６】　前記電子源は、複数の電子放出素子が結線された素子列の複数列がマトリクス配置されている電子源であることを特徴とする請求項４に記載の電子源。

【請求項７】　請求項４～６のいずれかに記載の電子源の製造に際し、前記電子放出素子を請求項３に記載の方法にて作製することを特徴とする電子源の製造方法。

【請求項８】　請求項１又は２に記載の電子放出素子と、画像形成部材と、前記電子放出素子から放出される電子線の前記画像形成部材への照射を情報信号に応じて制御する駆動手段とを有することを特徴とする画像形成装置。

【請求項９】　前記画像形成装置は、前記電子放出素子の複数が並列に結線された素子列を少なくとも１列以上有する画像形成装置であることを特徴とする請求項８に記載の画像形成装置。

【請求項１０】　前記画像形成装置は、前記電子放出素子の複数が結線された素子列の複数列がマトリクス配置されている画像形成装置であることを特徴とする請求項

2

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、冷陰極型の電子放出素子、該素子を多数個配置してなる電子源、及び該電子源を用いて構成した表示装置や露光装置等の画像形成装置に関し、特に電子放出素子の電気特性の均一化の技術に関する。

【０００２】

【従来の技術】従来、電子放出素子には大別して熱電子放出素子と冷陰極電子放出素子の２種類が知られている。冷陰極電子放出素子には電界放出型（以下、「ＦＥ型」と称す。）、金属／絶縁層／金属型（以下、「ＭＩＭ型」と称す。）や表面伝導型電子放出素子等が有る。

【０００３】ＦＥ型の例としては、Ｗ．Ｐ．Ｄｙｋｅ ａｎｄ Ｗ．Ｗ．Ｄｏｌａｎ，"Ｆｉｅｌｄ Ｅｍｉｓｓｉｏｎ"，Ａｄｖａｎｃｅ ｉｎ Ｅｌｅｃｔｒｏｎ Ｐｈｙｓｉｃｓ，８，８９（１９５６）あるいはＣ．Ａ．Ｓｐｉｎｄｔ，"Ｐｈｙｓｉｃａｌ Ｐｒｏｐｅｒｔｉｅｓ ｏｆ ｔｈｉｎ－ｆｉｌｍ ｆｉｅｌｄ ｅｍｉｓｓｉｏｎ ｃａｔｈｏｄｅｓ ｗｉｔｈ ｍｏｌｙｂｄｅｎｕｍ ｃｏｎｅｓ"，Ｊ．Ａｐｐｌ．Ｐｈｙｓ．，４７，５２４８（１９７６）等に開示されたものが知られている。

【０００４】ＭＩＭ型の例としては、Ｃ．Ａ．Ｍｅａｄ，"Ｏｐｅｒａｔｉｏｎ ｏｆ Ｔｕｎｎｅｌ－Ｅｍｉｓｓｉｏｎ Ｄｅｖｉｃｅｓ"，Ｊ．Ａｐｐｌ．Ｐｈｙｓ．，３２，６４６（１９６１）等に開示されたものが知られている。

【０００５】表面伝導型電子放出素子の例としては、Ｍ．Ｉ．Ｅｌｉｎｓｏｎ，Ｒａｄｉｏ Ｅｎｇ．Ｅｌｅｃｔｒｏｎ Ｐｈｙｓ．，１０，１２９０（１９６５）等に開示されたものがある。

【０００６】表面伝導型電子放出素子は、絶縁性基板上に形成された小面積の薄膜に、膜面に平行に電流を流すことにより、電子放出が生ずる現象を利用するものである。この表面伝導型電子放出素子としては、前記エリンソン等によるＳｎＯ２薄膜を用いたもの、Ａｕ薄膜によるもの［Ｇ．Ｄｉｔｔｍｅｒ："Ｔｈｉｎ Ｓｏｌｉｄ Ｆｉｌｍｓ"，９，３１７（１９７２）］，Ｉｎ２Ｏ３／ＳｎＯ２薄膜によるもの［Ｍ．Ｈａｒｔｗｅｌｌ ａｎｄ Ｃ．Ｇ．Ｆｏｎｓｔａｄ："ＩＥＥＥ Ｔｒａｎｓ．ＥＤ Ｃｏｎｆ．"，５１９（１９７

連結する金属酸化物等の導電性膜に、予めフォーミングと称される通電処理により電子放出部を形成したものが挙げられる。フォーミングは、導電性膜の両端に直流電圧あるいは非常にゆっくりとした昇電圧、例えば１Ｖ／１分程度の昇電圧を印加通電することで通常行われ、導電性膜を局所的に破壊、変形もしくは変質させて構造を変化させ、電気的に高抵抗な状態の電子放出部を形成する処理である。電子放出は、上記電子放出部が形成された導電性膜に電圧を印加して電流を流すことにより、電子放出部に発生した亀裂付近から行われる。

【０００９】上記表面伝導型電子放出素子は、構造が単純で製造も容易であることから、大面積に亙って多数配列形成できる利点がある。そこで、この特徴を活かすための種々の応用が研究されている。例えば表示装置等の画像形成装置への利用が挙げられる。

【００１０】従来、多数の表面伝導型電子放出素子を配列形成した例としては、並列に表面伝導型電子放出素子を配列し、個々の表面伝導型電子放出素子の両端（両素子電極）を配線（共通配線とも呼ぶ）にて夫々結線した行を多数行配列（梯型配置とも呼ぶ）した電子源が挙げられる（特開昭６４－３１３３２号公報、同１－２８３７４９号公報、同２－２５７５５２号公報）。また、特に表示装置においては、液晶を用いた表示装置と同様の平板型表示装置とすることが可能で、しかもバックライトが不要な自発光型の表示装置として、表面伝導型電子放出素子を多数配置した電子源と、この電子源からの電子線の照射により可視光を発光する蛍光体とを組み合わせた表示装置が提案されている（アメリカ特許第５０６６８８３号明細書）。

【００１１】

【発明が解決しようとする課題】しかしながら、前記従来のフォーミングは、通電によって発生するジュール熱により電子放出部を形成するものであるため、複数の電子放出素子間で導電性膜の形成状態等にバラツキがあると、電子放出部の亀裂形状や幅等にバラツキが生じ、各素子の電気特性にバラツキが生じる。このことは、特に前述した電子源や画像形成装置においては、輝度ムラや画像ムラが生じる原因となり、大きな問題であった。

【００１２】そこで、本発明の目的は、電子放出素子の電気特性を制御し、各電子放出素子間の特性のバラツキの極めて小さい電子源、さらには蛍光画像の輝度ムラ、表示ムラの極めて少ない画像形成装置を提供することにある。

成されていることを特徴とする電子放出素子に関する。

【００１５】また、本発明の第二は、上記本発明第一の電子放出素子の製造に際し、前記素子電極間に電圧を印加して該素子に流れる素子電流と該素子から放出される放出電流を検出し、該検出結果に基づき前記圧電体層に印加する電圧を制御して該圧電体層に逆圧電効果により発生する歪み量を制御することで、前記電子放出部の亀裂の幅を制御して、前記素子電流及び放出電流についての素子特性を制御する工程を有することを特徴とする電子放出素子の製造方法に関する。

【００１６】また、本発明の第三は、上記本発明第一の電子放出素子と該電子放出素子の駆動手段とを有することを特徴とする電子源に関する。

【００１７】上記本発明第三の電子源は、さらにその特徴として、「複数の電子放出素子が並列に結線された素子列を少なくとも１列以上有する」こと、「複数の電子放出素子が結線された素子列の複数列がマトリクス配置されている」こと、をも含むものである。

【００１８】また、本発明の第四は、上記本発明第三の電子源の製造に際し、前記電子放出素子を上記本発明第二の方法にて作製することを特徴とする電子源の製造方法に関する。

【００１９】また、本発明の第五は、上記本発明第一の電子放出素子と、画像形成部材と、前記電子放出素子から放出される電子線の前記画像形成部材への照射を情報信号に応じて制御する駆動手段とを有することを特徴とする画像形成装置に関する。上記本発明第五の画像形成装置は、さらにその特徴として、「前記電子放出素子の複数が並列に結線された素子列を少なくとも１列以上有する」こと、「前記電子放出素子の複数が結線された素子列の複数列がマトリクス配置されている」こと、「前記画像形成部材が、蛍光体である」こと、をも含むものである。

【００２０】さらに、本発明の第六は、上記本発明第五の画像形成装置の製造に際し、前記電子放出素子を上記本発明第二の方法にて作製することを特徴とする画像形成装置の製造方法に関する。

【００２１】

【発明の実施の形態】上記のように、本発明は、電子放出素子、この電子放出素子を複数個備えた電子源、これを用いた画像形成装置の新規な構造及び製造方法に係るもので、各発明の構成及び作用を以下に具に説明する。

子電極、6は圧電体層、7は圧電体用電極である。

【0024】基板1としては、例えば石英ガラス、Na等の不純物含有量を減少させたガラス、青板ガラス、青板ガラスにスパッタ法等によりSiO_2を積層した積層体、アルミナ等のセラミックス等が挙げられる。

【0025】対向する素子電極4，5及び圧電体用電極の材料としては、一般的導体材料が用いられ、例えばNi、Cr、Au、Mo、W、Pt、Ti、Al、Cu、Pd等の金属あるいは合金及びPd、Ag、Au、RuO_2、Pd－Ag等の金属あるいは金属酸化物とガラス等から構成される印刷導体、In$_2$O$_3$－SnO_2等の透明導電体及びポリシリコン等の半導体導体材料等から適宜選択される。

【0026】素子電極間隔L、導電性膜3の形状等は、応用される形態等によって設計される。

【0027】素子電極間隔Lは、数百オングストロームから数百マイクロメートルであることが好ましく、より好ましくは、素子電極4、5間に印加する電圧等により、数マイクロメートルから数十マイクロメートルである。また、素子電極厚dは、数百オングストロームから数マイクロメートルである。

【0028】導電性膜3は、良好な電子放出特性を得るためには、微粒子で構成された微粒子膜であることが特に好ましく、その膜厚は、素子電極4、5へのステップカバレージ、素子電極4、5間の抵抗値及び後述するフォーミング条件等によって適宜選択される。この導電性膜3の膜厚は、好ましくは数オングストロームから数千オングストロームで、特に好ましくは10オングストロームから500オングストロームであり、その抵抗値は、10の3乗から10の7乗オーム／□のシート抵抗値である。

【0029】上記微粒子膜とは、複数の微粒子が集合した膜であり、その微細構造として、微粒子が個々に分散配置した状態のみならず、微粒子が互いに隣接、あるいは重なり合った状態（いくつかの微粒子が集合し、全体として島状構造を形成している場合も含む）の膜をさす。

【0030】なお、本明細書では頻繁に「微粒子」という言葉を用いるので、その意味について説明する。

【0031】小さな粒子を「微粒子」と呼び、これよりも小さなものを「超微粒子」と呼ぶ。「超微粒子」よりもさらに小さく、原子の数が数百個程度以下のものを

行）では、「本稿で微粒子と言うときにはその直径がだいたい2～3μm程度から10nm程度までとし、特に超微粒子というときは粒径が10nm程度から2～3nm程度までを意味することにする。両者を一括して単に微粒子と言くこともあってけっして厳密なものではなく、だいたいの目安である。粒子を構成する原子の数が2個から数十～数百個程度の場合はクラスターと呼ぶ。」（195ページ　22～26行目）と記述されている。

【0034】付言すると、新技術開発事業団の"林・超微粒子プロジェクト"での「超微粒子」の定義は、粒径の下限はさらに小さく、次のようなものであった。

【0035】「創造科学技術推進制度の"超微粒子プロジェクト"（1981～1986）では、粒子の大きさ（径）がおよそ1～100nmの範囲のものを"超微粒子"(ultra fine particle)と呼ぶことにした。すると1個の超微粒子はおよそ10^0～10^3個くらいの原子の集合体という事になる。原子の尺度でみれば超微粒子は大～巨大粒子である。」（「超微粒子－創造科学技術」林主税、上田良二、田崎明　編；三田出版　1988年　2ページ1～4行目）／「超微粒子よりさらに小さいもの、すなわち原子が数個～数百個で構成される1個の粒子は、ふつうクラスターと呼ばれる」（同書2ページ12～13行目）。

【0036】上記のような一般的な呼び方をふまえて、本明細書において「微粒子」とは多数の原子・分子の集合体で、粒径の下限は数Å～10Å程度、上限は数μm程度のものを指すこととする。

【0037】導電性膜3を構成する材料としては、例えばPd，Pt，Ru，Ag，Au，Ti，In，Cu，Cr，Fe，Zn，Sn，Ta，W，Pb等の金属、PdO，SnO_2，In$_2$O$_3$，PbO，Sb$_2$O$_3$等の酸化物、HfB_2，ZrB_2，LaB_6，CeB_6，YB_6，GdB_6等の硼化物、TiC，ZrC，HfC，TaC，SiC，WCなどの炭化物、TiN，ZrN，HfN等の窒化物、Si，Ge等の半導体、カーボン等が挙げられる。

【0038】電子放出部2は、導電性膜3の一部に形成された亀裂であり、電子放出はこの亀裂付近から行われる。この亀裂は、導電性膜3の膜厚、膜質、材料及び後述するフォーミング条件等の製法に依存して形成される。従って、電子放出部2の位置及び形状は図1に示さ

酸バリウム、チタン酸鉛．ＰＺＴ、ニオブ酸鉛等が挙げられるが、これらに限定されるものではない。

【００４１】本発明に好適な表面伝導型電子放出素子の基本構成の製法としては様々な方法が考えられるが、その一例を図２に基づいて説明する。尚．図２において図１と同じ符号は同じ部材を示すものである。

【００４２】１）基板１を洗剤、純水及び有機溶剤により十分に洗浄した後、真空蒸着法、スパッタ法等により圧電体用電極材料を堆積させた後、フォトリソグラフィー技術等により基板１の面上に圧電体用電極７を形成する。次にスパッタ法やスプレー法等により圧電体層６を形成する（図２（ａ））。

【００４３】２）その後．真空蒸着法．スパッタ法等により素子電極材料を堆積させた後、フォトリソグラフィー技術等により基板１の面上に素子電極４，５を形成する。次に、素子電極４，５を設けた基板１上に有機金属溶液を塗布して放置することにより．素子電極４と素子電極５間を連絡して有機金属膜を形成する。尚．有機金属溶液とは、前述の導電性膜３の構成材料の金属を主元素とする有機化合物の溶液である。この後、有機金属膜を加熱焼成処理し、リフトオフ、エッチング等によりパターニングし．所望のパターン形状を有する導電性膜３を形成する（図２（ｂ））。

【００４４】尚．ここでは．有機金属溶液の塗布法により説明したが．これに限ることなく．例えば真空蒸着法．スパッタ法．化学的気相堆積法．分散塗布法．ディッピング法、スピンナー法等によって有機金属膜を形成することもできる。

【００４５】３）続いて．通電処理によるフォーミング工程を施す。素子電極４．５間に不図示の電源より通電すると、導電性膜３の部位に亀裂からなる電子放出部２が形成される。続いて．電子放出部２の亀裂部分の下の圧電体層をエッチングにて除去する（図２（ｃ））。

【００４６】通電フォーミングの電圧波形の例を図３に示す。

【００４７】電圧波形は．特にパルス波形が好ましく、パルス波高値を定電圧とした電圧パルスを連続的に印加する場合（図３（ａ））と．パルス波高値を増加させながら電圧パルスを印加する場合（図３（ｂ））とがある。

【００４８】まず、パルス波高値を定電圧とした場合について図３（ａ）で説明する。

波等の所望の波形を用いても良く、その波高値及びパルス幅・パルス間隔等についても上述の値に限るものではなく．電子放出部２が良好に形成されるように．電子放出素子の抵抗値等に合わせて所望の値を選択することができる。

【００５０】次に、パルス波高値を増加させながら電圧パルスを印加する場合について図３（ｂ）で説明する。

【００５１】図３（ｂ）におけるＴ１及びＴ２は図３（ａ）と同様であり、波高値（フォーミング時のピーク電圧）を、例えば０．１Ｖステップ程度ずつ増加させ、図３（ａ）の説明と同様の適当な真空雰囲気下で印加する。

【００５２】尚．パルス間隔Ｔ２中に．導電性膜３を局所的に破壊、変形もしくは変質させない程度の電圧、例えば０．１Ｖ程度の電圧で素子電流を測定して抵抗値を求め．例えば１Ｍオーム以上の抵抗を示したときにフォーミングを終了することが好ましい。

【００５３】上記フォーミング工程からそれ以降の工程は．図４に示されるような測定評価系内で行うことができる。この測定評価系について説明する。

【００５４】図４において．図１と同じ符号は同じ部材を示す。また．５１は素子に素子電圧Ｖｆを印加するための電源、５０は素子電極４，５間の導電性膜３を流れる素子電流Ｉｆを測定するための電流計、５４は電子放出部２より放出される放出電流Ｉｅを捕捉するためのアノード電極、５３はアノード電極５４に電圧を印加するための高圧電源．５２は電子放出部２より放出される放出電流Ｉｅを測定するための電流計．５５は素子電極４と圧電体用電極６との間に圧電体駆動電圧を印加するための電源、５６は素子電流Ｉｅ及び放出電流Ｉｆの検出結果に基づき電源５５の電圧を制御する電圧制御手段、５７は真空装置．５８は排気ポンプである。

【００５５】電子放出素子及びアノード電極５４等は真空装置５７内に設置され．この真空装置５７には不図示の真空計等の必要な機器が具備されていて、所望の真空下で電子放出素子の測定評価ができるようになっている。

【００５６】排気ポンプ５６は、ターボポンプ．ロータリーポンプ等からなる通常の高真空装置系と、イオンポンプ等からなる超高真空装置系とから構成されている。また．真空装置５５全体及び電子放出素子の基板１は、ヒーターにより２００℃程度まで加熱できるようになっ

1kV～10kVを印加する。このときに流れる素子電流If及び放出電流Ieを電流計50及び52で検出し、この検出結果に基づき電圧制御手段56により電源55の電圧を制御して圧電体層6に所望の電圧を印加する。これにより圧電体層6には逆圧電効果により歪みが発生し、導電性膜3に機械的に歪みを発生させることができ、この導電性膜3に発生した歪みの大きさにより、電子放出部2の亀裂幅が変化するため、素子の電気特性が変化する。

【0058】上記の導電性膜3に発生する歪み量の制御は、圧電体層6に印加する電圧を制御することで行うことができる。即ち、圧電体層6に印加する電圧を制御することで、素子の電気特性を制御することができる。

【0059】一般に、フォーミング直後の素子の放出電流Ieは極めて小さく、上記操作により、徐々に亀裂形状を変化させ、放出電流Ieを高めることができる。従って、上記操作において、素子電圧Vfを一定にしたまま、放出電流Ieが所定の値になるまで圧電体層6に印加する電圧を制御することにより、所定の電子放出特性を有する素子形態に整形することができ、特性の揃った多数の素子を作製することができる。

【0060】上記操作によって電子放出特性が改善されるのは、上記操作に伴って、電子放出部2を含む領域に炭素あるいは炭素化合物が堆積するためでもある。このように電子放出部2を含む領域に炭素あるいは炭素化合物を堆積させる処理は、活性化処理と呼ばれる。

【0061】電子放出部2を含む領域に炭素あるいは炭素化合物を堆積する手法としては、通常の真空蒸着、スパッタ、CVD、イオンプレーティング等の手法によっても可能であるが、有機物質の存在する真空雰囲気下で、上記のように素子電極4，5間に電圧を印加する手法が簡易であることからより好ましい。特に、表面伝導型電子放出素子の場合には、この手法により電子放出特性の著しい改善がなされる。

【0062】活性化処理工程での有機物質の存在する真空雰囲気は、例えば油拡散ポンプやロータリーポンプなどを用いて真空容器内を排気した場合に雰囲気内に残留する有機ガスを利用して形成することができる他、イオンポンプなどにより一旦十分に排気した真空中に適当な有機物質のガスを導入することによっても得られる。このときの好ましい有機物質のガス圧は、前述の応用の形態、真空容器の形状や、有機物質の種類などにより異なる

ため一概に言い得ないが、例えばアセトン、メチルエチルケトン、メチルアミン、エチルアミン、フェノール、蟻酸、酢酸、プロピオン酸等が使用できる。この処理により、雰囲気中に存在する有機物質から、炭素あるいは炭素化合物が素子上に堆積し、素子電流If，放出電流Ieが、著しく変化するようになる。

【0063】上記炭素及び炭素化合物とは、例えばグラファイト（いわゆるHOPG，PG（，GC）を包含し、HOPGはほぼ完全なグラファイトの結晶構造、PGは結晶粒が200Å程度で結晶構造がやや乱れたもの、GCは結晶粒が20Å程度になり結晶構造の乱れがさらに大きくなったものを指す。）、非晶質カーボン（アモルファスカーボン及び、アモルファスカーボンと前記グラファイトの微結晶の混合物を指す）であり、その堆積膜厚は、好ましくは500オングストローム以下、より好ましくは300オングストローム以下である。

【0064】5）このようにして作製した電子放出素子を、フォーミング工程、活性化工程での真空度より高い真空度の真空雰囲気下で動作駆動する、安定化工程を施すことが好ましい。より好ましくは、この高い真空度の真空雰囲気下で、80～150℃の加熱の後、動作駆動する。

【0065】尚、フォーミング工程、活性化工程の真空度より高い真空度の真空雰囲気とは、例えば約10の－6乗torr以上の真空度を有する真空雰囲気であり、より好ましくは超高真空系であり、炭素及び炭素化合物が新たにほぼ堆積しない真空度である。

【0066】即ち、電子放出素子を上記真空雰囲気中に封入してしまうことにより、これ以上の炭素あるいは炭素化合物の堆積を抑制することが可能となり、これによって素子電流If、放出電流Ieが安定する。

【0067】以上のようにして得られる表面伝導型電子放出素子の基本特性について、以下に説明する。

【0068】以下に述べる表面伝導型電子放出素子の基本特性は、図4の測定評価系のアノード電極54の電圧を1kV～10kVとし、アノード電極54と表面伝導型電子放出素子の距離Hを2～8mmとして、通常測定を行う。

【0069】まず、放出電流Ie及び素子電流Ifと、素子電圧Vfとの関係の典型的な例を図5に示す。尚、

h）を超える素子電圧Ｖｆを印加すると急激に放出電流Ｉｅが増加し、一方しきい値電圧Ｖｔｈ以下では放出電流Ｉｅが殆ど検出されない。即ち、放出電流Ｉｅに対する明確なしきい値電圧Ｖｔｈを持った非線形素子である。

【００７２】第２に、放出電流Ｉｅが素子電圧Ｖｆに対して単調増加する特性（ＭＩ特性と呼ぶ）を有するため、放出電流Ｉｅは素子電圧Ｖｆで制御できる。

【００７３】第３に、アノード電極５４（図４参照）に捕捉される放出電荷は、素子電圧Ｖｆを印加する時間に依存する。即ち、アノード電極５４に捕捉される電荷量は、素子電圧Ｖｆを印加する時間により制御できる。

【００７４】放出電流Ｉｅが素子電圧Ｖｆに対してＭＩ特性を有すると同時に、素子電流Ｉｆも素子電圧Ｖｆに対してＭＩ特性を有する場合もある。このような表面伝導型電子放出素子の特性の例が図５の（ａ）に示す特性である。一方、図５の（ｂ）に示すように、素子電流Ｉｆは素子電圧Ｖｆに対して電圧制御型負性抵抗特性（ＶＣＮＲ特性と呼ぶ）を示す場合もある。いずれの特性を示すかは、表面伝導型電子放出素子の製法及び測定時の測定条件等に依存する。但し、素子電流Ｉｆが素子電圧Ｖｆに対してＶＣＮＲ特性を有する表面伝導型電子放出素子でも、放出電流Ｉｅは素子電圧Ｖｆに対してＭＩ特性を有する。

【００７５】以上のような本発明による表面伝導型電子放出素子の特徴的特性のため、複数の素子を配置した電子源や画像形成装置でも、入力信号に応じて、容易に放出電子量を制御することができることとなり、多方面への応用が可能である。

【００７６】次に、本発明の電子源の一例として前述の表面伝導型電子放出素子を複数配置した電子源について述べる。まず、表面伝導型電子放出素子の配列方式について説明する。

【００７７】本発明の電子源における表面伝導型電子放出素子の配列方式としては、従来の技術の項で述べたような梯型配置の他、ｍ本のＸ方向配線の上にｎ本のＹ方向配線を層間絶縁層を介して設置し、表面伝導型電子放出素子の一対の素子電極に夫々Ｘ方向配線、Ｙ方向配線を接続した配置方式が挙げられる。これを以後単純マトリクス配置と呼ぶ。まず、この単純マトリクス配置について詳述する。

【００７８】前述した表面伝導型電子放出素子の基本的

量が制御でき、単純なマトリクス配線だけで個別の表面伝導型電子放出素子を選択して独立に駆動可能となる。

【００７９】単純マトリクス配置はこのような原理に基づくもので、本発明の電子源の一例である、この単純マトリクス配置の電子源の構成について図６に基づいて更に説明する。

【００８０】図６において基板１は既に説明したようなガラス板等であり、この基板１上に配列された本発明による表面伝導型電子放出素子１０４の個数及び形状は用途に応じて適宜設定されるものである。

【００８１】ｍ本のＸ方向配線１０２は、夫々外部端子Ｄｘ１，Ｄｘ２，……，Ｄｘｍを有するもので、基板１上に、真空蒸着法、印刷法、スパッタ法等で形成した導電性金属等である。また、多数の表面伝導型電子放出素子１０４にほぼ均等に電圧が供給されるように、材料、膜厚、配線幅が設定されている。

【００８２】ｎ本のＹ方向配線１０３は、夫々外部端子Ｄｙ１，Ｄｙ２，……，Ｄｙｎを有するもので、Ｘ方向配線１０２と同様に作成される。

【００８３】これらｍ本のＸ方向配線１０２とｎ本のＹ方向配線１０３間には、不図示の層間絶縁層が設置され、電気的に分離されて、マトリクス配線を構成している。尚、このｍ、ｎは共に正の整数である。

【００８４】不図示の層間絶縁層は、真空蒸着法、印刷法、スパッタ法等で形成されたSiO_2等であり、Ｘ方向配線１０２を形成した基板１の全面或は一部に所望の形状で形成され、特に、Ｘ方向配線１０２とＹ方向配線１０３の交差部の電位差に耐え得るように、膜厚、材料、製法が適宜設定される。Ｘ方向配線１０２とＹ方向配線１０３は、それぞれ外部端子として引き出されている。

【００８５】更に、表面伝導型電子放出素子１０４の対向する素子電極（不図示）が、ｍ本のＸ方向配線１０２と、ｎ本のＹ方向配線１０３と、真空蒸着法、印刷法、スパッタ法等で形成された導電性金属等からなる結線１０５によって電気的に接続されているものである。

【００８６】ここで、ｍ本のＸ方向配線１０２と、ｎ本のＹ方向配線１０３と、結線１０５と、対向する素子電極とは、その構成元素の一部あるいは全部が同一であっても、また夫々異なっていてもよく、前述の素子電極の材料等より適宜選択される。これら素子電極への配線は、素子電極と材料が同一である場合は素子電極と総称

【００８８】一方、Ｙ方向配線１０３には、Ｙ方向に配列された表面伝導型電子放出素子１０４の列の各列を入力信号に応じて変調するために、変調信号を印加する不図示の変調信号発生手段が電気的に接続されている。更に、各表面伝導型電子放出素子１０４に印加される駆動電圧は、当該表面伝導型電子放出素子１０４に印加される走査信号と変調信号の差電圧として供給されるものである。

【００８９】次に、以上のような単純マトリクス配置の電子源を用いて構成される本発明の画像形成装置の一例を、図７～図９を用いて説明する。尚、図７は表示パネル２０１の基本構成図であり、図８は蛍光膜１１４を示す図であり、図９は図８の表示パネル２０１で、ＮＴＳＣ方式のテレビ信号に応じてテレビジョン表示を行うための駆動回路の一例を示すブロック図である。

【００９０】図７において、１は上述のようにして表面伝導型電子放出素子を配置した電子源の基板、１１１は基板１を固定したリアプレート、１１６はガラス基板１１３の内面に蛍光膜１１４とメタルバック１１５等が形成されたフェースプレート、１１２は支持枠であり、リアプレート１１１、支持枠１１２及びフェースプレート１１６にフリットガラス等を塗布し、大気中あるいは窒素中で、４００～５００℃で１０分以上焼成することで封着して外囲器１１８を構成している。

【００９１】図７において、１０２、１０３は、表面伝導型電子放出素子１０４の一対の素子電極４，５（図１参照）と接続されたＸ方向配線及びＹ方向配線で、夫々外部端子Ｄｘ１ないしＤｘｍ，Ｄｙ１ないしＤｙｎを有している。

【００９２】外囲器１１８は、上述の如く、フェースープレート１１６、支持枠１１２、リアプレート１１１で構成されている。しかし、リアプレート１１１は主に基板１の強度を補強する目的で設けられるものであり、基板１自体で十分な強度を持つ場合は別体のリアプレート１１１は不要で、基板１に直接支持枠１１２を封着し、フェースプレート１１６、支持枠１１２、基板１にて外囲器１１８を構成してもよい。また、フェースプレート１１６、リアプレート１１１の間にスペーサーと呼ばれる不図示の支持体を更に設置することで、大気圧に対して十分な強度を有する外囲器１１８とすることもできる。

【００９３】蛍光膜１１４は、モノクロームの場合は蛍

る外光反射によるコントラストの低下を抑制することである。黒色導伝材１２１の材料としては、通常良く用いられている黒鉛を主成分とする材料だけでなく、導電性があり、光の透過及び反射が少ない材料であれば他の材料を用いることもできる。

【００９４】ガラス基板１１３に蛍光体１２２を塗布する方法としては、モノクローム、カラーによらず、沈澱法や印刷法が用いられる。

【００９５】また、図７に示されるように、蛍光膜１１４の内面側には通常メタルバック１１５が設けられる。メタルバック１１５の目的は、蛍光体１２２（図８参照）の発光のうち内面側への光をフェースプレート１１６側へ鏡面反射することにより輝度を向上すること、電子ビーム加速電圧を印加するための電極として作用すること、外囲器１１８内で発生した負イオンの衝突によるダメージからの蛍光体１２２の保護等である。メタルバック１１５は、蛍光膜１１４の作製後、蛍光膜１１４の内面側表面の平滑化処理（通常フィルミングと呼ばれる）を行い、その後Ａｌを真空蒸着等で堆積することで作製できる。

【００９６】フェースプレート１１６には、更に蛍光膜１１４の導伝性を高めるため、蛍光膜１１４の外面側に透明電極（不図示）を設けてもよい。

【００９７】前述の封着を行う際、カラーの場合は各色蛍光体１２２と表面伝導型電子放出素子１０４とを対応させなくてはいけないため、十分な位置合わせを行なう必要がある。

【００９８】外囲器１１８内は、不図示の排気管を通じて排気し、所定の真空度に達した後、封止される。また、外囲器１１８の封止後の真空度を維持するためにゲッター処理を行うこともできる。これは、外囲器１１８の封止を行う直前あるいは封止後に抵抗加熱あるいは高周波加熱等により、外囲器１１８内の所定の位置に配置したゲッター（不図示）を加熱し、蒸着膜を形成する処理である。ゲッターは通常Ｂａ等が主成分であり、該蒸着膜の吸着作用により、例えば１×１０の－５乗ないしは１×１０の－７乗ｔｏｒｒの真空度を維持するためのものである。

【００９９】尚、前述したフォーミング処理以降の表面伝導型電子放出素子の各製造工程は、通常、外囲器１１８の封止直前又は封止後に行われるもので、その内容は前述した通りである。

しＤｙｎ及び高圧端子Ｈｖを介して外部の電気回路と接続されている。この内、外部端子Ｄｘ１ないしＤｘｍには前記表示パネル２０１内に設けられている表面伝導型電子放出素子．即ちｍ行ｎ列の行列状にマトリクス配置された表面伝導型電子放出素子群を１行（ｎ素子ずつ）順次駆動して行くための走査信号が印加される。

【０１０２】一方、端子Ｄｙ１ないし外部端子Ｄｙｎには．前記走査信号により選択された１行の各表面伝導型電子放出素子の出力電子ビームを制御するための変調信号が印加される。また、高圧端子Ｈｖには、直流電圧源Ｖａより、例えば１０ｋＶの直流電圧が供給される。これは表面伝導型電子放出素子より出力される電子ビームに．蛍光体を励起するのに十分なエネルギーを付与するための加速電圧である。

【０１０３】走査回路２０２は、内部にｍ個のスイッチング素子（図９中Ｓ１ないしＳｍで模式的に示す）を備えるもので、各スイッチング素子Ｓ１～Ｓｍは．直流電圧電源Ｖｘの出力電圧もしくは０Ｖ（グランドレベル）のいずれか一方を選択して．表示パネル２０１の外部端子Ｄｘ１ないしＤｘｍと電気的に接続するものである。各スイッチング素子Ｓ１～Ｓｍは、制御回路２０３が出力する制御信号Ｔｓｃａｎに基づいて動作するもので、実際には、例えばＦＥＴのようなスイッチング機能を有する素子を組み合わせることにより容易に構成することが可能である。

【０１０４】本例における前記直流電圧源Ｖｘは．前記表面伝導型電子放出素子の特性（しきい値電圧）に基づき．走査されていない表面伝導型電子放出素子に印加される駆動電圧がしきい値電圧以下となるような一定電圧を出力するよう設定されている。

【０１０５】制御回路２０３は、外部より入力される画像信号に基づいて適切な表示が行われるように．各部の動作を整合させる働きを持つものである。次に説明する同期信号分離回路２０６より送られる同期信号Ｔｓｙｎｃに基づいて．各部に対してＴｓｃａｎ、Ｔｓｆｔ及びＴｍｒｙの各制御信号を発生する。

【０１０６】同期信号分離回路２０６は、外部から入力されるＮＴＳＣ方式のテレビ信号から．同期信号成分と輝度信号成分を分離するための回路で．よく知られているように、周波数分離（フィルター）回路を用いれば、容易に構成できるものである。同期信号分離回路２０６により分離された同期信号は、これもよく知られるよう

回路２０３より送られる制御信号Ｔｓｆｔに基づいて作動する。この制御信号Ｔｓｆｔは、シフトレジスタ２０４のシフトクロックであると言い換えてもよい。また、シリアル／パラレル変換された画像１ライン分（表面伝導型電子放出素子のｎ素子分の駆動データに相当する）のデータは、Ｉｄ１ないしＩｄｎのｎ個の並列信号として前記シフトレジスタ２０４より出力される。

【０１０８】ラインメモリ２０５は．画像１ライン分のデータを必要時間だけ記憶するための記憶装置であり、制御回路２０３より送られる制御信号Ｔｍｒｙに従って適宜Ｉｄ１ないしｉｄｎの内容を記憶する。記憶された内容は、Ｉｄ′１ないしＩｄ′ｎとして出力され．変調信号発生器２０７に入力される。

【０１０９】変調信号発生器２０７は．前記画像データＩｄ′１ないしＩｄ′ｎの各々に応じて、表面伝導型電子放出素子の各々を適切に駆動変調するための信号源で．その出力信号は、端子Ｄｙ１ないしＤｙｎを通じて表示パネル２０１内の表面伝導型電子放出素子に印加される。

【０１１０】前述したように、表面伝導型電子放出素子は電子放出に明確なしきい値電圧を有しており．しきい値電圧を超える電圧が印加された場合にのみ電子放出が生じる。また．しきい値電圧を超える電圧に対しては表面伝導型電子放出素子への印加電圧の変化に応じて放出電流も変化して行く。表面伝導型電子放出素子の材料、構成．製造方法を変えることにより．しきい値電圧の値や印加電圧に対する放出電流の変化度合いが変わる場合もあるが、いずれにしても以下のことがいえる。

【０１１１】即ち、表面伝導型電子放出素子にパルス状の電圧を印加する場合、例えばしきい値電圧以下の電圧を印加しても電子放出は生じないが．しきい値電圧を超える電圧を印加する場合には電子放出を生じる。その際．第１には電圧パルスの波高値を変化させることにより．出力される電子ビームの強度を制御することが可能である。第２には、電圧パルスの幅を変化させることにより．出力される電子ビームの電荷の総量を制御することが可能である。

【０１１２】従って、入力信号に応じて表面伝導型電子放出素子を変調する方式としては、電圧変調方式とパルス幅変調方式とが挙げられる。電圧変調方式を行う場合．変調信号発生器２０７としては．一定の長さの電圧パルスを発生するが、入力されるデータに応じて適宜パ

所定の速度で行えるものであればよい。

【0114】デジタル信号式を用いる場合には、同期信号分離回路206の出力信号DATAをデジタル信号化する必要がある。これは同期信号分離回路206の出力部にA／D変換器を設けることで行える。

【0115】また、これと関連して、ラインメモリ205の出力信号がデジタル信号かアナログ信号かにより、変調信号発生器207に設けられる回路が若干異なるものとなる。

【0116】即ち、デジタル信号で電圧変調方式の場合、変調信号発生器207には、例えばよく知られているD／A変換回路を用い、必要に応じて増幅回路等を付け加えればよい。また、デジタル信号でパルス幅変調方式の場合、変調信号発生器207は、例えば高速の発振器及び発振器の出力する波数を計数する計数器（カウンタ）及び計数器の出力値と前記メモリの出力値を比較する比較器（コンパレータ）を組み合わせた回路を用いることで容易に構成することができる。更に、必要に応じて、比較器の出力するパルス幅変調された変調信号を表面伝導型電子放出素子の駆動電圧にまで電圧増幅するための増幅器を付け加えてもよい。

【0117】一方、アナログ信号で電圧変調方式の場合、変調信号発生器207には、例えばよく知られているオペアンプ等を用いた増幅回路を用いればよく、必要に応じてレベルシフト回路等を付け加えてもよい。また、アナログ信号でパルス幅変調方式の場合、例えばよく知られている電圧制御型発振回路（VCO）を用いればよく、必要に応じて表面伝導型電子放出素子の駆動電圧にまで電圧増幅するための増幅器を付け加えてもよい。

【0118】以上のような表示パネル201及び駆動回路を有する本発明に係る画像形成装置は、端子Dx1～Dxm及びDy1～Dynから電圧を印加することにより、必要な表面伝導型電子放出素子から電子を放出させることができ、高圧端子Hvを通じて、メタルバック115あるいは透明電極（不図示）に高電圧を印加して電子ビームを加速し、加速した電子ビームを蛍光膜114に衝突させることで生じる励起・発光によって、NTSC方式のテレビ信号に応じてテレビジョン表示を行うことができるものである。

【0119】尚、以上説明した構成は、表示等に用いられる本発明の画像形成装置を得る上で必要な概略構成であり、例えば各部材の材料等、詳細な部分は上述の内容

【0120】次に、前述の梯型配置の電子源及びこれを用いて構成される本発明の画像形成装置の一例について図10及び図11を用いて説明する。

【0121】図10において、1は基板、104は表面伝導型電子放出素子、304は表面伝導型電子放出素子104を接続する共通配線で10本設けられており、各々外部端子D1～D10を有している。

【0122】表面伝導型電子放出素子104は、基板1上に並列に複数個配置されている。これを素子行と呼ぶ。そしてこの素子行が複数行配置されて電子源を構成している。

【0123】各素子行の共通配線304（例えば外部端子D1とD2の共通配線304）間に適宜の駆動電圧を印加することで、各素子行を独立に駆動することが可能である。即ち、電子ビームを放出させたい素子行にはしきい値電圧を超える電圧を印加し、電子ビームを放出させたくない素子行にはしきい値電圧以下の電圧を印加するようにすればよい。このような駆動電圧の印加は、各素子行間に位置する共通配線D2～D9について、夫々相隣接する共通配線304、即ち夫々相隣接する外部端子D2とD3、D4とD5、D6とD7、D8とD9の共通配線304を一体の同一配線としても行うことができる。

【0124】図11は、上記梯型配置の電子源を備えた表示パネル301の構造を示す図である。

【0125】図11中302はグリッド電極、303は電子が通過するための開口、D1～Dmは各表面伝導型電子放出素子に電圧を印加するための外部端子、G1～Gnはグリッド電極302に接続された外部端子である。また、各素子行間の共通配線304は一体の同一配線として基板1上に形成されている。

【0126】尚、図11において図7と同じ符号は同じ部材を示すものであり、図7に示される単純マトリクス配置の電子源を用いた表示パネル201との大きな違いは、基板1とフェースプレート116の間にグリッド電極302を備えている点である。

【0127】基板1とフェースプレート116の間には、上記のようにグリッド電極302が設けられている。このグリッド電極302は、表面伝導型電子放出素子104から放出された電子ビームを変調することができるもので、梯型配置の素子行と直行して設けられたストライプ状の電極に、電子ビームを通過させるために、

示の駆動回路に接続されている。そして、素子行を1列ずつ順次駆動（走査）して行くのと同期してグリッド電極302の列に画像1ライン分の変調信号を印加することにより、各電子ビームの蛍光膜114への照射を制御し、画像を1ラインずつ表示することができる。

【0130】以上のように、本発明の画像形成装置は、単純マトリクス配置及び梯型配置のいずれの本発明の電子源を用いても得ることができ、上述したテレビジョン放送の表示装置のみならず、テレビ会議システム、コンピューター等の表示装置として好適な画像形成装置が得られる。更には、感光ドラムとで構成した光プリンターの露光装置としても用いることができるものである。

【0131】

【実施例】以下に、具体的な実施例を挙げて本発明を詳しく説明するが、本発明はこれら実施例に限定されるものではなく、本発明の目的が達成される範囲内での各要素の置換や設計変更がなされたものをも包含する。

【0132】（実施例1～7）本実施例の表面伝導型電子放出素子の構成は、図1に示されるものと同様であり、図2の製造工程図に基づきその製造方法を以下に説明する。

【0133】工程－1

十分に洗浄した青板ガラス基板1を用い、真空蒸着法により厚さ5ナノメートルのTi、厚さ100ナノメートルのNiを順次堆積した。フォトリソグラフィ法によりパターニングを行い、圧電体用電極を形成した（図2（a））。

【0134】工程－2

次に、各実施例として、表1に示す材料を用いてスパッタ法やスプレー法により圧電体層6を形成した（図2（a））。

【0135】工程－3

次に、真空蒸着法により厚さ5ナノメートルのTi、厚さ100ナノメートルのNiを順次堆積した。フォトリソグラフィ法によりパターニングを行い、素子電極間隔Lが3μmの素子電極4、5を形成した（図2（b））。

【0136】工程－4

＊次に、有機Pd錯体（ccp4230・奥野製薬（株）製）をスピンナーにより回転塗布し、300℃で10分間の加熱焼成処理を行った後、フォトリソグラフィ法により所定の形状にパターニングして導電性膜3を形成した（図2（b））。

【0137】工程－5

上記工程を経た基板1を図4の測定評価系の真空容器55内に設置し、真空ポンプにて排気して、2×10の－5乗torrの真空度に達した後、素子電圧Vfを印加するための電源51より素子電極4、5間に電圧を印加し、通電処理（フォーミング処理）を施して電子放出部2を形成した（図2（c））。

【0138】工程－6

次に、電子放出部2の亀裂部分の下の圧電体層をエッチングにて除去した（図2（c））。

【0139】工程－7

基板1を図4の測定評価系の真空容器55内に設置し、まず素子電極4、5間に電源51によって素子電圧Vfを印加するとともに、アノード電極54に高圧電源53によって1kV～10kVを印加する。このときに流れる素子電流If及び放出電流Ieを電流計50及び52で検出し、この検出結果に基づき電圧制御手段56により電源55の電圧を制御して圧電体層6に所望の電圧を印加した。

【0140】各実施例における圧電体層6に用いた材料の等価圧電定数は表1に示す通りであり、例えば、圧電定数がd_{31}＝10pm／Vの圧電材料の場合には、約1Vの印加電圧により、電子放出部2の亀裂幅の制御を100nm程度の範囲で行うことができる。

【0141】以上の操作では、亀裂幅の制御とともに、先述したような活性化処理も同時に行われた。

【0142】上記操作において、素子電圧Vfを一定にしたまま、放出電流Ieが所定の値になるまで圧電体層6に印加する電圧を制御したところ、特性の揃った多数の素子を作製することができた。

【0143】

【表1】

＊

	圧電体層の材料	等価圧電定数 d_{31}（×10^{-12}m／V）
実施例1	水晶	－2.0
実施例2	チタン酸バリウム	－58

子源．及び図７に示したような画像形成装置を作製した。

【０１４５】電子源の製造は、実施例１～７の電子放出素子の製造方法を拡張して行うことができ、その詳細は省略する。

【０１４６】次に、前記のように作製した複数の導電性膜がマトリクス配線された基板１（図６参照）を用いて画像形成装置を構成した例を、図７及び図８を参照して具体的に、上述のようにして複数の導電性膜がマトリクス配線された基板１（図６参照）をリアプレート１１１上に固定した後、基板１の４ｍｍ上方に、フェースプレート１１６（ガラス基板１１３の内面に蛍光膜１１４とメタルバック１１５が形成されて構成される）を支持枠１１２を介して配置し、フェースプレート１１６、支持枠　１１２、リアプレート１１１の接合部にフリットガラスを塗布し、大気中で４３０℃で１０分以上焼成することで封着した。またリアプレート１１１への基板１の固定もフリットガラスで行った。

【０１４７】蛍光膜１１４は、モノクロームの場合は蛍光体１２２のみからなるが、本実施例では蛍光体１２２はストライプ形状（図８（ａ））を採用し、先にブラックストライプを形成し、その間隙部に各色蛍光体１２２を塗布して蛍光膜１１４を作製した。ブラックストライプの材料としては、通常よく用いられている黒鉛を主成分とする材料を用いた。

【０１４８】ガラス基板１１３に蛍光体１２２を塗布する方法としてはスラリー法を用いた。また、蛍光膜１１４の内面側にはメタルバック１１５を設けた。メタルバック１１５は、蛍光膜１１４の作製後、蛍光膜１１４の内面側表面の平滑化処理（通常フィルミングと呼ばれる）を行い、その後、Ａｌを真空蒸着することで作製した。

【０１４９】フェースプレート１１６には、更に蛍光膜１１４の導電性を高めるため、蛍光膜１１４の外面側に透明電極（不図示）が設けられる場合もあるが、本実施例では、メタルバック１１５のみで十分な導電性が得られたので省略した。

【０１５０】前述の封着を行う際、カラーの場合は各色蛍光体１２２と表面伝導型電子放出素子１０４とを対応させなくてはいけないため、十分な位置合わせを行った。

【０１５１】以上のようにして完成した外囲器１１８内

【０１５３】その後、外囲器１１８内の雰囲気を排気管（図示せず）を通し真空ポンプにて１０の－６．５乗ｔｏｒｒ程度の真空度まで排気し、不図示の排気管をガスバーナーで熱することで溶着し、外囲器１１８の封止を行い、更に封止後の真空度を維持するために、高周波加熱法でゲッター処理を行った。

【０１５４】以上のように完成した本発明の画像形成装置において、外部端子Ｄｘ１ないしＤｘｍとＤｙ１ないしＤｙｎを通じ、走査信号及び変調信号を不図示の信号発生手段より夫々表面伝導型電子放出素子１０４に印加することにより電子放出させると共に、高圧端子Ｈｖを通じてメタルバック１１４に数ｋＶ以上の高圧を印加して、電子ビームを加速し、蛍光膜１１５に衝突させ、励起・発光させることで画像の表示が得られた。

【０１５５】

【発明の効果】以上説明したように、本発明の電子放出素子及び電子源は、圧電体層６に印加する電圧を制御することで、電子放出部２の亀裂形状を制御し、電子放出特性を制御できる。このため、極めて均一で、電子放出特性の揃った素子を得ることができる。

【０１５６】これにより、本発明の電子源及び画像形成装置は、輝度ムラ、画像ムラの無い極めて高品位な装置となった。

【図面の簡単な説明】

【図１】本発明の電子放出素子の実施態様例を示す概略的構成図である。

【図２】本発明の電子放出素子の製造工程を説明するための図である。

【図３】フォーミング波形の例を示す図である。

【図４】本発明の電子放出素子の測定評価系の一例を示す概略的構成図である。

【図５】本発明の表面伝導型電子放出素子の電気特性を示す図である。

【図６】単純マトリクス配置の本発明の電子源の概略的構成図である。

【図７】単純マトリクス配置の電子源を用いた本発明の画像形成装置の概略的構成図である。

【図８】図７の表示パネルにおける蛍光膜を示す図である。

【図９】図７の表示パネルを駆動する駆動回路の一例を示す図である。

【図１０】梯型配置の電子源の概略的平面図である。

【図１１】梯型配置の電子源を用いた本発明の画像形成

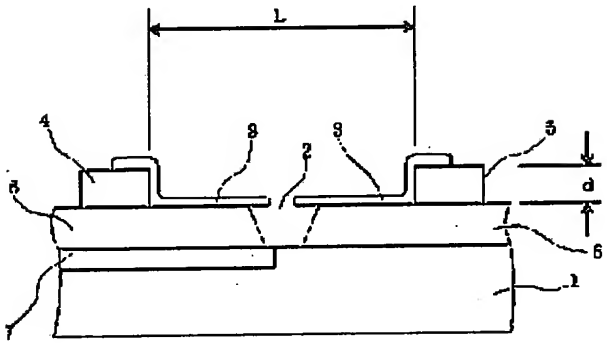
23

7　圧電体用電極
５０　素子電流Ｉｆを測定するための電流計
５１　電源
５２　放出電流Ｉｅを測定するための電流計
５３　高圧電源
５４　アノード電極
５５　電源
５６　電圧制御手段
５７　真空装置
５８　排気ポンプ
１０２　Ｘ方向配線
１０３　Ｙ方向配線
１０４　表面伝導型電子放出素子
１０５　結線
１１１　リアプレート
１１２　支持枠
１１３　ガラス基板
１１４　蛍光膜

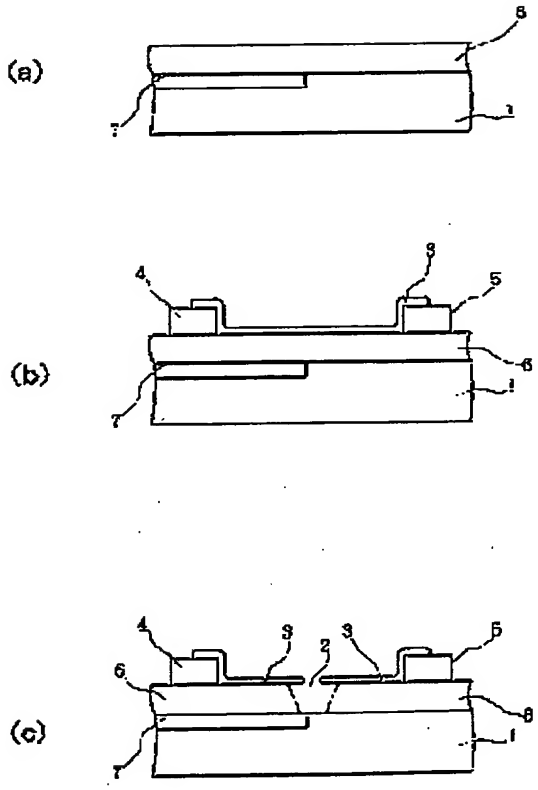
24

＊１１５　メタルバック
１１６　フェースプレート
１１８　外囲器
１２１　黒色導伝材
１２２　蛍光体
１２３　ＥＶ端子
２０１　表示パネル
２０２　走査回路
２０３　制御回路
２０４　シフトレジスタ
２０５　ラインメモリ
２０６　同期信号分離回路
２０７　変調信号発生器
３０１　表示パネル
３０２　グリッド電極
３０３　開口
３０４　共通配線
＊

【図１】



【図２】



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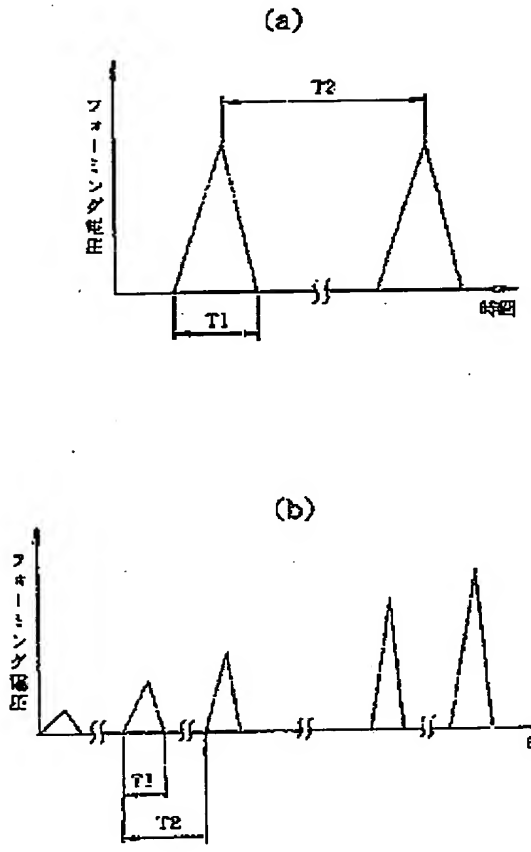
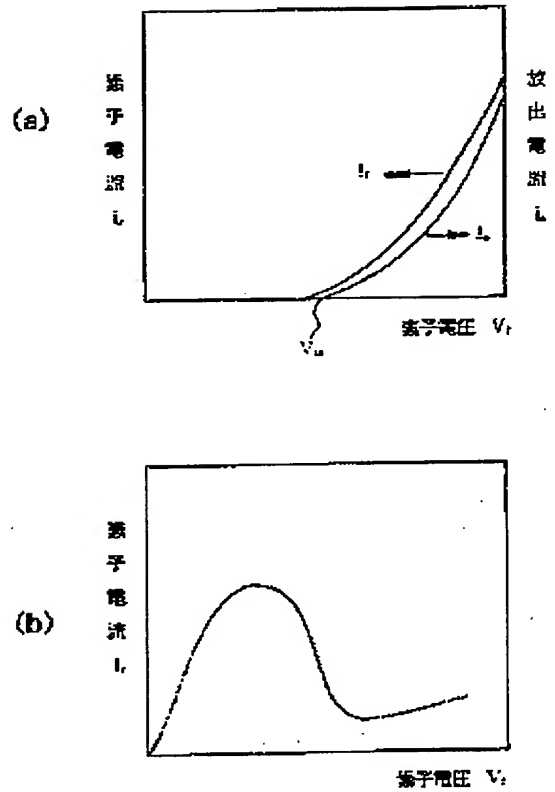
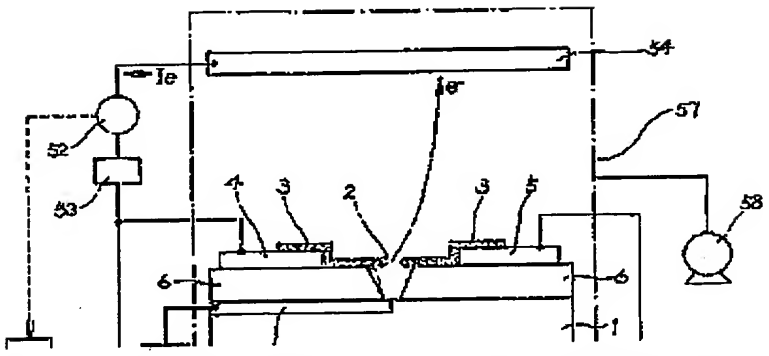

(a)
T2
T1
時間
(b)
T1
T2
時間

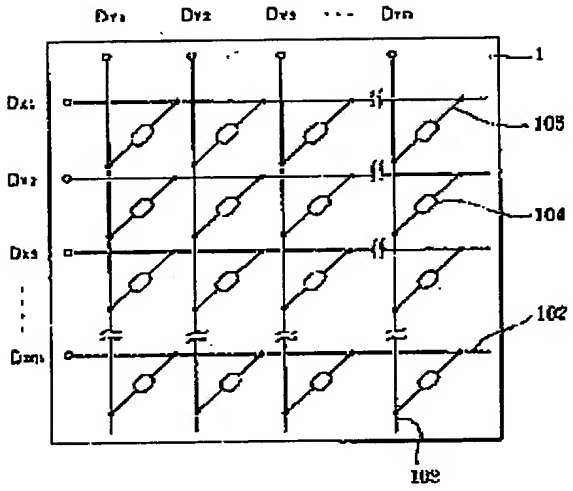
【図５】


(a)
放出電流 i_e
素子電圧 V_f
(b)
素子電流 i_f
素子電圧 V_f

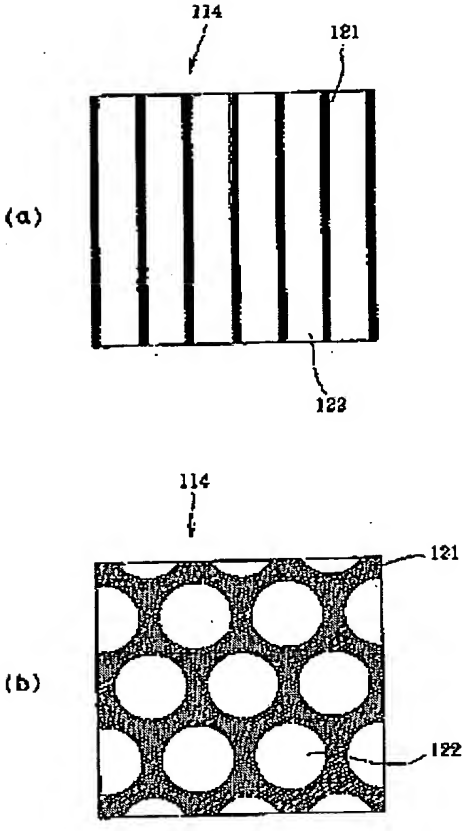
【図４】


54
Ie
52
53
57
58
4
3
2
3
5
6
6
1

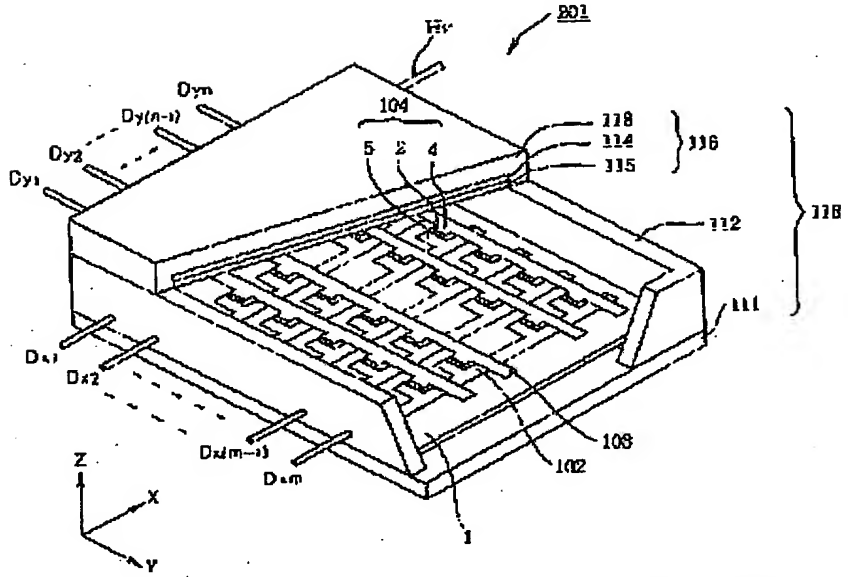
【図6】


Dy1
Dy2
Dy3
Dym
Dx1
Dx2
Dx3
Dxm
1
105
104
102
103

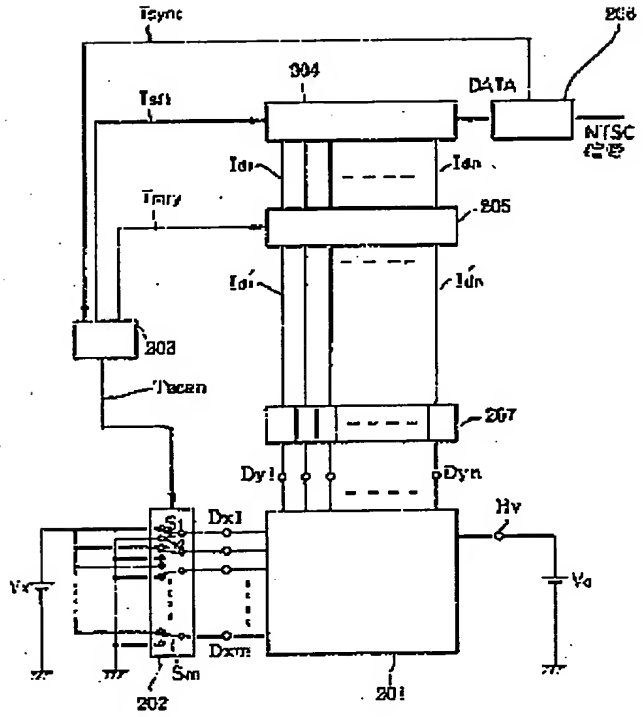
【図8】


(a)
114
121
123
(b)
114
121
122

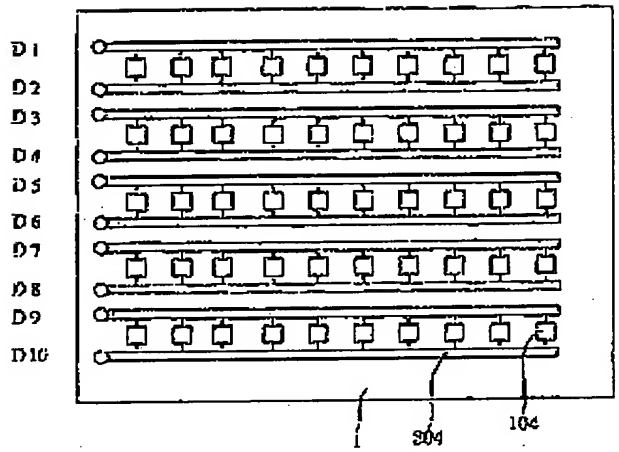
【図7】


201
Hv
Dym
Dy(n-1)
Dy2
Dy1
104
5
2
4
118
114
115
116
112
111
118
Dx1
Dx2
Dx(m-1)
Dxm
108
102
1
Z
X
Y

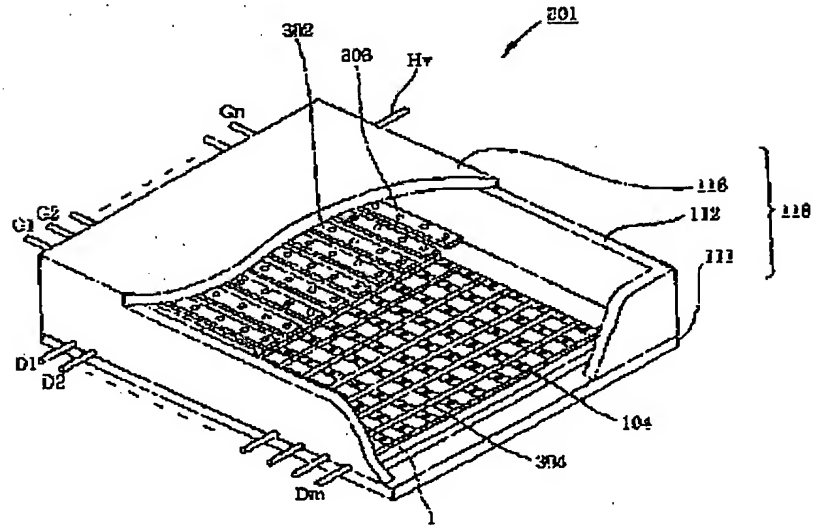
【図９】


Tsync
306
304
DATA
Tsft
NTSC
Tdy
305
Tscan
307
Dy1
Dyn
Hv
Dx1
Vx
Vo
Dxm
Sm
202
201

【図１０】


D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
1
304
104

【図１１】


201
302
306
Hv
Gn
G1
G2
116
112
118
111
D1
D2
104
304
Dm
1

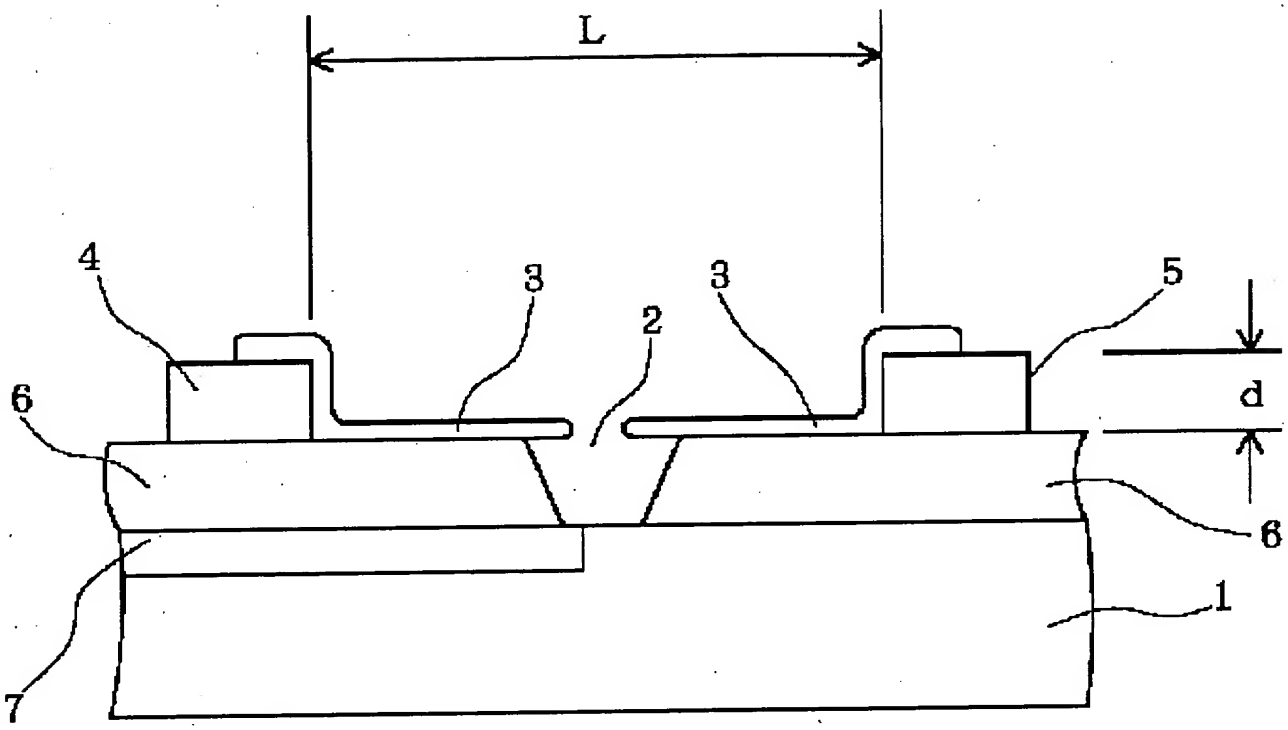
* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The electron emission component characterized by forming the piezo electric crystal layer and the electrode for piezo electric crystals in component inter-electrode among said conductive film bordering on said electron emission section at one [at least] side in the electron emission component which has the conductive film with which the electron emission section was formed.
[Claim 2] Said electron emission component is an electron emission component according to claim 1 characterized by being a surface conduction mold electron emission component.
[Claim 3] On the occasion of manufacture of an electron emission component according to claim 1 or 2, the component current which impresses an electrical potential difference to said component inter-electrode, and flows for this component, and the emission current emitted from this component are detected. By controlling the amount of distortion which controls the electrical potential difference impressed to said piezo electric crystal layer based on this detection result, and is generated according to an inverse piezolectric effect in this piezo electric crystal layer The manufacture approach of the electron emission component characterized by having the process which controls the width of face of the crack of said electron emission section, and controls the component property about said component current and the emission current.
[Claim 4] The electron source characterized by having the driving means of an electron emission component according to claim 1 or 2 and this electron emission component.
[Claim 5] Said electron source is an electron source according to claim 4 characterized by two or more electron emission components being the electron sources which have at least one or more trains of element arrays by which connection was carried out to juxtaposition.
[Claim 6] Said electron source is an electron source according to claim 4 characterized by two or more trains of the element array with which connection of two or more electron emission components was carried out being the electron sources by which matrix arrangement is carried out.
[Claim 7] The manufacture approach of the electron source characterized by producing said electron emission component by the approach according to claim 3 on the occasion of manufacture of an electron source according to claim 4 to 6.
[Claim 8] Image formation equipment characterized by having the driving means which controls the exposure to an electron emission component according to claim 1 or 2, an image formation member, and said image formation member of the electron ray emitted from said electron emission component according to an information signal.
[Claim 9] Said image formation equipment is image formation equipment according to claim 8 characterized by being image formation equipment with which the plurality of said electron emission component has at least one or more trains of element arrays by which connection was carried out to juxtaposition.
[Claim 10] Said image formation equipment is image formation equipment according to claim 8 characterized by being image formation equipment with which matrix arrangement of two or more trains of the element array with which connection of the plurality of said electron emission component was carried out is carried out.
[Claim 11] Image formation equipment according to claim 8 to 10 with which said image formation member is characterized by being a fluorescent substance.
[Claim 12] The manufacture approach of the image formation equipment characterized by producing said electron emission component by the approach according to claim 3 on the occasion of manufacture of image formation equipment according to claim 8 to 11.

[Translation done.]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* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the technique of equalization of the electrical property of an electron emission component especially about image formation equipments constituted using the electron source which comes to arrange a majority of electron emission components and these components and this electron source of a cold cathode mold, such as a display and an aligner.
[0002]
[Description of the Prior Art] Conventionally, it divides roughly into an electron emission component, and two kinds, a thermionic emission component and a cold cathode electron emission component, are known. There are a field emission mold ("FE mold" is called hereafter.), a metal / insulating layer / metal mold (an "MIM mold" is called hereafter.), a surface conduction mold electron emission component, etc. as cold cathode electron emission component.
[0003] As an example of FE mold W. P. Dyke and W.W. Dolan and "Field Emission", Advance in Electron Physics 8, 89 (1956), or C.A. Spindt "Physical Properties of thin-filmfield emission cathodes with molybdenum cones" J. Appl. Phys. What was indicated by 47, 5248 (1976), etc. is known.
[0004] As an example of an MIM mold, it is C.A. Mead "Operation ofTunnel-Emission Devices" J. Appl.Phys. What was indicated by 32,646 (1961) etc. is known.
[0005] As an example of a surface conduction mold electron emission component, it is M.I. Elinson Radio Eng. Electron Phys. There are some which were indicated by 10, 1290 (1965), etc.
[0006] A surface conduction mold electron emission component uses the phenomenon which electron emission produces by passing a current at parallel at a film surface in the thin film of the small area formed on the insulating substrate. As this surface conduction mold electron emission component, it is SnO2 by said Elinson etc. The thing using a thin film, Thing [G. by Au thin film Dittmer: "Thin Solid Films", 9,317(1972)], In 2O3 / SnO2 Thing [M. by the thin film Hartwell and C.G. Fonstad: "IEEE Trans. ED Conf.", 519(1975)], Others [/ by the carbon thin film / thing [Araki **]: A vacuum, the 26th volume, No. 1, 22-page (1983)], etc. are reported.
[0007] A surface conduction mold electron emission component uses the phenomenon which electron emission produces by passing a current at parallel at a film surface on the conductive film formed on the insulating substrate.
[0008] What formed the electron emission section by energization processing beforehand called foaming is mentioned to conductive film, such as a metallic oxide which connects the component inter-electrode of the couple prepared on the insulating substrate as a typical example of a configuration of a surface conduction mold electron emission component. foaming is usually performed to the ends of the conductive film by carrying out impression energization of direct current voltage or the rising voltage carried out very slowly, for example, 1V / rising voltage for about 1 minute, breaks, deforms or deteriorates the conductive film locally, and changes structure -- making -- electric -- high -- it is the processing which forms the electron emission section of a condition [****]. Electron emission is performed from near the crack generated in the electron emission section by impressing an electrical potential difference to the conductive film with which the above-mentioned electron emission section was formed, and passing a current.
[0009] Since structure is simple and manufacture is also easy structure, the above-mentioned surface conduction mold electron emission component covers a large area, and has the advantage which can carry out a large number array formation. Then, the various application for harnessing this description is studied. For example, utilization to image formation equipments, such as a display, is mentioned.
[0010] Conventionally, as an example which carried out array formation of many surface conduction mold electron emission components, a surface conduction mold electron emission component is arranged to juxtaposition, and the electron source which carried out the line array (it is also called ladder type arrangement) of many lines which

connected the ends (both components electrode) of each surface conduction mold electron emission component with wiring (it is also called common wiring), respectively is mentioned (JP,64-31332,A, a 1-283749 official report, 2-257552 official report). Moreover, especially in the display, the display which combined the electron source to which it was possible to have considered as the display using liquid crystal and the same plate mold display, and the back light has moreover arranged many surface conduction mold electron emission components as an unnecessary spontaneous light type display, and the fluorescent substance which emits light in the light by the exposure of the electron ray from this electron source is proposed (the U.S. patent No. 5066883 description).

[0011]

[Problem(s) to be Solved by the Invention] However, since it is what forms the electron emission section with the Joule's heat generated by energization, if said conventional foaming has variation in the formation condition of the conductive film etc. among two or more electron emission components, variation will arise to a crack configuration, width of face, etc. of the electron emission section, and variation will produce it in the electrical property of each component. In the electron source and image formation equipment which were mentioned above, especially this became the cause which brightness nonuniformity and image nonuniformity produce, and was a big problem.

[0012] Then, the object of this invention controls the electrical property of an electron emission component, and is to offer [the very small electron source of the variation in the property between each electron emission component and] very little image formation equipment of the brightness nonuniformity of a fluorescence image, and display nonuniformity further.

[0013]

[Means for Solving the Problem] The configuration of this invention accomplished that the above-mentioned object should be attained is as follows.

[0014] That is, it is related with the electron emission component characterized by forming the piezo electric crystal layer and the electrode for piezo electric crystals in component inter-electrode among said conductive film bordering on said electron emission section the first of this invention at one [at least] side in the electron emission component which has the conductive film with which the electron emission section was formed.

[0015] Moreover, manufacture of the electron emission component of above-mentioned this invention first is faced the second of this invention. The component current which impresses an electrical potential difference to said component inter-electrode, and flows for this component, and the emission current emitted from this component are detected. By controlling the amount of distortion which controls the electrical potential difference impressed to said piezo electric crystal layer based on this detection result, and is generated according to an inverse piezolectric effect in this piezo electric crystal layer It is related with the manufacture approach of the electron emission component characterized by having the process which controls the width of face of the crack of said electron emission section, and controls the component property about said component current and the emission current.

[0016] Moreover, the third of this invention is related with the electron source characterized by having the driving means of the electron emission component of above-mentioned this invention first, and this electron emission component.

[0017] The third above-mentioned electron source of this invention also contains further what "it has for at least one or more trains of element arrays with which connection of two or more electron emission components was carried out to juxtaposition", and the thing "done for the matrix arrangement of two or more trains of the element array with which connection of two or more electron emission components was carried out" as the description.

[0018] Moreover, the fourth of this invention is related with the manufacture approach of the electron source characterized by producing said electron emission component by the second above-mentioned approach of this invention on the occasion of manufacture of the third above-mentioned electron source of this invention.

[0019] Moreover, the fifth of this invention is related with the image formation equipment characterized by having the driving means which controls the exposure to the electron emission component of above-mentioned this invention first, an image formation member, and said image formation member of the electron ray emitted from said electron emission component according to an information signal. The image formation equipment of above-mentioned this invention fifth also contains further what "the plurality of said electron emission component has for at least one or more trains of element arrays by which connection was carried out to juxtaposition", the thing "done for the matrix arrangement of two or more trains of the element array with which connection of the plurality of said electron emission component was carried out", and the thing "which said image formation member is also a fluorescent substance" as the description.

[0020] Furthermore, the sixth of this invention is related with the manufacture approach of the image formation equipment characterized by producing said electron emission component by the second above-mentioned approach of this invention on the occasion of manufacture of the image formation equipment of above-mentioned this invention

fifth.
[0021]
[Embodiment of the Invention] As mentioned above, this invention relates to the new structure and the manufacture approach of an electron emission component, the electron source equipped with two or more these electron emission components, and the image formation equipment using this, and explains the configuration and operation of each invention further below.
[0022] The electron emission component concerning this invention is classified into the electron emission component of a cold cathode mold which carried out point **, and the electron emission component of a surface conduction mold is suitable for it especially from viewpoints, such as the electron emission characteristic, also in them. For this reason, below, a surface conduction mold electron emission component is mentioned as an example, and is explained.
[0023] Drawing 1 (a) and (b) are drawings showing the fundamental configuration of the surface conduction mold electron emission component of this invention, and, for the electron emission section and 3, as for a component electrode and 6, the conductive film, and 4 and 5 are [one / a substrate and 2 / a piezo electric crystal layer and 7] the electrodes for piezo electric crystals among drawing.
[0024] As a substrate 1, it is SiO2 by a spatter etc. to the glass which decreased impurity contents, such as quartz glass and Na, for example, blue plate glass, and blue plate glass. Ceramics which carried out the laminating, such as a layered product and an alumina, is mentioned.
[0025] As an ingredient of the component electrodes 4 and 5 which counter, and the electrode for piezo electric crystals Common conductor material is used. For example, nickel, Cr, Au, Mo, W, Pt, Metals, such as Ti, aluminum, Cu, and Pd, or an alloy, and Pd, Ag, Au, the printed conductor which consists of a metal or a metallic oxide, glass, etc., such as RuO2 and Pd-Ag, and In2 O3-SnO2 etc. -- it is suitably chosen from semi-conductor conductor material, such as a transparence conductor and polish recon, etc.
[0026] The configuration of the component electrode spacing L and the conductive film 3 etc. is designed by the gestalt applied.
[0027] As for the component electrode spacing L, it is desirable that it is hundreds of micrometers from hundreds of A, and it is dozens of micrometers from several micrometers more preferably by the component electrode 4, the electrical potential difference impressed among five. Moreover, the component electrolyte thickness d is several micrometers from hundreds of A.
[0028] As for the conductive film 3, it is desirable that it is especially the particle film which consisted of particles in order to acquire the good electron emission characteristic, and the thickness is suitably chosen by resistance, foaming conditions mentioned later between the step coverage to the component electrodes 4 and 5, the component electrode 4, and 5. The thickness of this conductive film 3 is thousands of A from several angstroms preferably, it is 500A from 10A especially preferably, and that resistance is sheet resistance of the 7th power ohm / ** of 10 from the cube of 10.
[0029] The above-mentioned particle film is film with which two or more particles gathered, and not only the condition that the particle distributed separately but a particle puts mutually the film in contiguity or the condition (it contains, also when some particles gather and island-like structure is formed as a whole) of having overlapped, as the fine structure.
[0030] In addition, since the language "particle" is frequently used on these descriptions, the semantics is explained.
[0031] A "particle", a call, and what is smaller than this are called a "ultrafine particle" for a small particle. It is still smaller than a "ultrafine particle", and it is performed widely that the number of atomic calls a "cluster" about hundreds of or less things.
[0032] However, each boundary is not strict and it changes by paying attention to what kind of property it classifies. Moreover, a "particle" and a "ultrafine particle" may be collectively called a "particle", and description in this description meets this.
[0033] "An experimental physics lecture 14 front face and a particle" (the volume on Koreo Kinoshita , KYORITSU SHUPPAN September 1, 1986 issuance) "when calling it a particle in this paper, the diameter carries out to from about 2-3 micrometers to about 10nm generally, and when calling it especially an ultrafine particle, particle size will mean from about 10nm to about 2-3nm. Since both are only collectively written to be particles, it is by no means strict, and they are most rules of thumb. In the case of dozens - about 100 numbers, the number of the atoms which constitute a particle calls it a cluster from two pieces. It is described as " (195 pages the 22-26th line).
[0034] When added, the minimum of particle size was still smaller and that of the definition of the "ultrafine particle" in "the wood and ultrafine particle project" of the Research Development Corporation of Japan was as follows.
[0035] "In the "ultrafine particle project" (1981-1986) of Exploratory Research for Advanced Technology, it decided to call the thing of the range whose magnitude (path) of a particle is about 1-100nm a "ultrafine particle" (ultra fine

particle). Then, one ultrafine particle is about 100-108. It will be called the aggregate of the atom like an individual. if it sees with an atomic scale, ultrafine particles will be size - a giant particle. what is still smaller than a"(volume "ultrafine particle-creation technology" wood Chikara, Ryoji Ueda, and on Tazaki ** ; Mita publication 1-4th 1988 2 pages line)/"ultrafine particle, i.e., an atom, -- some - one particle which consists of hundreds of pieces is usually called a cluster -- " (this two-page writing of the 12-13th line) .

[0036] Based on the above general ways of calling, in this description, a "particle" is the aggregate of many atoms and molecules, and suppose that the minimum of particle size points out several angstroms - about 10A, and an upper limit points out an about several micrometers thing.

[0037] As an ingredient which constitutes the conductive film 3, for example Metals, such as Pd, Pt, Ru, Ag, Au, Ti, In, Cu, Cr, Fe, Zn, Sn, Ta, W, and Pb, PdO, SnO2, In 2O3, PbO, and Sb 2O3 etc. -- an oxide -- HfB2, ZrB2 and LaB6, CeB6, YB4, and GdB4 etc. -- semi-conductors, such as nitrides, such as carbide, such as boride, and TiC, ZrC, HfC, TaC, SiC, WC, and TiN, ZrN, HfN, and Si, germanium, carbon, etc. are mentioned.

[0038] The electron emission section 2 is the crack formed in some conductive film 3, and electron emission is performed from near [this] a crack. This crack is formed depending on processes, such as thickness of the conductive film 3, membraneous quality, an ingredient, and foaming conditions mentioned later. Therefore, the location and configuration of the electron emission section 2 are not specified as a location and a configuration as shown in drawing 1 .

[0039] Inside a crack, it may have a conductive particle with a particle size of several angstroms to hundreds of A. This conductive particle is the same as that of some elements of the ingredient which constitutes the conductive film 3, or all. Moreover, as for the electron emission section 2 and the conductive film 3 of the near, it is desirable to have the film which uses carbon as a principal component.

[0040] As an ingredient of the piezo electric crystal layer 6, although Xtal, barium titanate, lead titanate, PZT, lead niobate, etc. are mentioned, it is not limited to these.

[0041] Although various approaches as a process of the basic configuration of the suitable surface conduction mold electron emission component for this invention can be considered, the example is explained based on drawing 2 . In addition, in drawing 2 , the same sign as drawing 1 R> 1 shows the same member.

[0042] 1) Form the electrode 7 for piezo electric crystals on the field of a substrate 1 with a photolithography technique etc. after a detergent, pure water, and an organic solvent fully wash a substrate 1 and making the electrode material for piezo electric crystals deposit by the vacuum deposition method, a spatter, etc. Next, the piezo electric crystal layer 6 is formed with a spatter, a spray method, etc. (drawing 2 (a)).

[0043] 2) Form the component electrodes 4 and 5 on the field of a substrate 1 with a photolithography technique etc. after making a component electrode material deposit by the vacuum deposition method, a spatter, etc. after that. Next, by applying and leaving an organic metal solution on the substrate 1 which formed the component electrodes 4 and 5, between the component electrode 4 and the component electrode 5 is connected, and the organic metal film is formed. In addition, an organic metal solution is a solution of the organic compound which uses the metal of the component of the above-mentioned conductive film 3 as the main element. Then, heating baking processing of the organic metal film is carried out, patterning is carried out by the lift off, etching, etc., and the conductive film 3 which has a desired pattern configuration is formed (drawing 2 (b)).

[0044] In addition, although explained by the method of applying an organic metal solution, the organic metal film can also be formed here, for example by vacuum evaporation technique, a spatter, modified chemical vapor deposition, the distributed applying method, the dipping method, the spinner method, etc., without restricting to this.

[0045] 3) Then, give the foaming process by energization processing. If it energizes from a non-illustrated power source between the component electrode 4 and 5, the electron emission section 2 which consists of a crack will be formed in the part of the conductive film 3. Then, the piezo electric crystal layer under the crack part of the electron emission section 2 is removed by etching (drawing 2 (c)).

[0046] The example of the voltage waveform of energization foaming is shown in drawing 3 .

[0047] Especially a voltage waveform has a desirable pulse shape, and it may impress an electrical-potential-difference pulse, making the case (drawing 3 (a)) where the electrical-potential-difference pulse which made the pulse height value the constant voltage is impressed continuously, and a pulse height value increase (drawing 3 (b)).

[0048] First, drawing 3 (a) explains the case where a pulse height value is made into a constant voltage.

[0049] It is the pulse width and pulse separation of a voltage waveform, for example, T1 is made into 1 microsecond - 10 mses, they make T2 10 microseconds - 100 mses, and T1 and T2 in drawing 3 (a) choose it suitably according to the gestalt of the electron emission component which mentioned above peak value (peak voltage at the time of foaming), and they are impressed from several seconds for dozens minutes under the vacuum ambient atmosphere of a degree of

vacuum with suitable - 5th power torr extent of 10. In addition, the voltage waveform to impress is not limited to the chopping sea illustrated, and the wave of requests, such as a square wave, may be used for it, and it cannot restrict it to an above-mentioned value about the peak value, and pulse width, pulse separation, etc., and it can choose a desired value according to the resistance of an electron emission component etc. so that the electron emission section 2 may be formed good.

[0050] Next, drawing 3 (b) explains the case where an electrical-potential-difference pulse is impressed, making a pulse height value increase.

[0051] T1 and T2 in drawing 3 (b) -- drawing 3 (a) -- the same -- peak value (peak voltage at the time of foaming) -- for example, it is made to increase 0.1V step extent every, and impresses under the same suitable vacuum ambient atmosphere as explanation of drawing 3 (a).

[0052] In addition, it is desirable to end foaming, when a component current is measured on the electrical potential difference of extent which the conductive film 3 breaks and deforms or does not deteriorate it locally, for example, an about [0.1V] electrical potential difference, and resistance is calculated, for example, resistance beyond 1M ohm is shown in pulse separation T2.

[0053] The process after it can be performed within a measurement assessment system as shown in drawing 4 from the above-mentioned foaming process. This measurement assessment system is explained.

[0054] In drawing 4 , the same sign as drawing 1 shows the same member. Moreover, an ammeter for a power source for 51 to impress the component electrical potential difference Vf to a component and 50 to measure the component current If which flows the component electrode 4 and the conductive film 3 between five, An anode electrode for 54 to catch the emission current Ie emitted from the electron emission section 2, An ammeter for a high voltage power supply for 53 to impress an electrical potential difference to the anode electrode 54 and 52 to measure the emission current Ie emitted from the electron emission section 2, As for a power source for 55 to impress piezo electric crystal driver voltage between the component electrode 4 and the electrode 6 for piezo electric crystals, an armature-voltage control means by which 56 controls the electrical potential difference of a power source 55 based on the detection result of the component current Ie and the emission current If, and 57, vacuum devices and 58 are exhaust air pumps.

[0055] An electron emission component and anode electrode 54 grade are installed in vacuum devices 57, the device which needs a non-illustrated vacuum gage etc. for these vacuum devices 57 possesses them, and measurement assessment of an electron emission component has come to be able to do them under a desired vacuum.

[0056] The exhaust air pump 56 consists of a usual high vacuum equipment system which consists of a turbine pump, a rotary pump, etc., and an ultra-high-vacuum equipment system which consists of an ion pump etc. Moreover, the substrate 1 of the vacuum-devices 55 whole and an electron emission component can be heated now to about 200 degrees C at a heater. In addition, in the assembly phase of a display panel which is mentioned later, this measurement assessment system is constituting a display panel and its interior as vacuum devices 57 and its interior, and is applied to the measurement assessment and processing in a foaming process and the process after it mentioned later.

[0057] 4) In the configuration shown in drawing 4 , while impressing the component electrical potential difference Vf according to a power source 51 between the component electrode 4 and 5 first, impress 1kV - 10kV to the anode electrode 54 by the high voltage power supply 53. Ammeters 50 and 52 detect the component current If and the emission current Ie which flow at this time, the electrical potential difference of a power source 55 is controlled by the armature-voltage control means 56 based on this detection result, and a desired electrical potential difference is impressed to the piezo electric crystal layer 6. Since the crack width of face of the electron emission section 2 changes, the electrical property of a component changes with the magnitude of distortion which distortion could occur according to the inverse piezolectric effect in the piezo electric crystal layer 6 by this, and the conductive film 3 could be made to generate distortion mechanically, and was generated on this conductive film 3.

[0058] Control of the amount of distortion generated on the above-mentioned conductive film 3 can be performed by controlling the electrical potential difference impressed to the piezo electric crystal layer 6. That is, the electrical property of a component is controllable by controlling the electrical potential difference impressed to the piezo electric crystal layer 6.

[0059] Generally, the emission current Ie of the component just behind foaming is very small, by the above-mentioned actuation, can change a crack configuration gradually and can raise the emission current Ie. Therefore, in the above-mentioned actuation, with the component electrical potential difference Vf fixed, by controlling the electrical potential difference impressed to the piezo electric crystal layer 6, it can operate orthopedically in the component gestalt which has the predetermined electron emission characteristic, and many components to which the property was equal can be produced until the emission current Ie becomes a predetermined value.

[0060] The electron emission characteristic is improved by the above-mentioned actuation for carbon or a carbon

compound accumulating on the field which contains the electron emission section 2 with the above-mentioned actuation. Thus, the processing in which carbon or a carbon compound is made to deposit on the field containing the electron emission section 2 is called activation.

[0061] As the technique of depositing carbon or a carbon compound on the field containing the electron emission section 2, it is more desirable from the technique of impressing an electrical potential difference between the component electrode 4 and 5 as mentioned above also by technique, such as the usual vacuum deposition, a spatter, CVD, and ion plating, under the vacuum ambient atmosphere in which an organic substance exists, although it is possible being simple. Especially, in the case of a surface conduction mold electron emission component, a remarkable improvement of the electron emission characteristic is made by this technique.

[0062] When the inside of a vacuum housing is exhausted using for example, oil diffusion HOMPU, a rotary pump, etc., it can form using the organic gas which remains in an ambient atmosphere, and also the vacuum ambient atmosphere in which the organic substance in an activation process exists is acquired by introducing the gas of an organic substance suitable in the vacuum once exhausted fully with the ion pump etc. Since it changes with the gestalt of the above-mentioned application, the configuration of a vacuum housing, classes of organic substance, etc., the gas pressure of the desirable organic substance at this time is suitably set up according to a case. As a suitable organic substance, an alkane, an alkene, and the aliphatic hydrocarbon of an alkyne Organic acids, such as aromatic hydrocarbon, alcohols, aldehydes, ketones, amines, a phenol, carvone, and a sulfonic acid, can be mentioned. Specifically The saturated hydrocarbon expressed with Cn H2n+2, such as methane, ethane, and a propane, The unsaturated hydrocarbon expressed with empirical formulas, such as Cn H2n, such as ethylene and a propylene, Benzene, toluene, a methanol, ethanol, formaldehyde, an acetaldehyde, an acetone, a methyl ethyl ketone, monomethylamine, ethylamine, a phenol, formic acid, an acetic acid, a propionic acid, etc. can be used. Carbon or a carbon compound accumulates on a component, and the component current If and the emission current Ie come to change with these processings from the organic substance which exists in an ambient atmosphere remarkably.

[0063] The above-mentioned carbon and a carbon compound are graphite (the so-called HOPG and PG (GC) are included). crystal grain becomes about 20A and, as for the thing and GC to which, as for the crystal structure of graphite with nearly perfect HOPG, and PG, the crystal structure was confused a little by crystal grain by about 200A, points out that it became large [turbulence of the crystal structure] further [that]. It is amorphous carbon (the mixture of amorphous carbon and amorphous carbon, and the microcrystal of said graphite is pointed out), and 500A or less of the deposition thickness is 300A or less more preferably.

[0064] 5) It is desirable to give the stabilization process which carries out actuation of the electron emission component which carried out in this way and was produced of operation under the vacuum ambient atmosphere of a degree of vacuum higher than the degree of vacuum in a foaming process and an activation process. Actuation of operation is more preferably carried out after 80-150-degree C heating under the vacuum ambient atmosphere of this high degree of vacuum.

[0065] In addition, the vacuum ambient atmosphere of a degree of vacuum higher than the degree of vacuum of a foaming process and an activation process is a vacuum ambient atmosphere which has a degree of vacuum for example, more than about 10 6th [-] power torr, is an ultra-high-vacuum system more preferably, and is a degree of vacuum which carbon and a carbon compound do not newly deposit mostly.

[0066] That is, by enclosing an electron emission component into the above-mentioned vacuum ambient atmosphere, it becomes possible to control deposition of the carbon beyond this, or a carbon compound, and the component current If and the emission current Ie are stabilized by this.

[0067] The basic property of the surface conduction mold electron emission component obtained as mentioned above is explained below.

[0068] The basic property of the surface conduction mold electron emission component described below sets the electrical potential difference of the anode electrode 54 of the measurement assessment system of drawing 4 to 1kV - 10kV, sets distance H of the anode electrode 54 and a surface conduction mold electron emission component to 2-8mm, and usually measures.

[0069] First, the typical examples of relation with the component electrical potential difference Vf are indicated to be the emission current Ie and the component current If to drawing 5 . In addition, in (a) of drawing 5 , since the emission current Ie is remarkably small compared with the component current If, it is shown per arbitration. In addition, an axis of ordinate and an axis of abscissa are linear scales.

[0070] A surface conduction mold electron emission component has the following three characteristic properties over the emission current Ie so that clearly from (a) of drawing 5 .

[0071] First, if a surface conduction mold electron emission component impresses the component electrical potential

difference Vf exceeding a certain electrical potential difference (: called as a threshold electrical potential difference Vth in (a) of drawing 5), the emission current Ie will increase rapidly and, on the other hand, the emission current Ie will hardly be detected below on the threshold electrical potential difference Vth by the 1st. That is, it is a nonlinear element with the clear threshold electrical potential difference Vth to the emission current Ie.

[0072] Since it has [2nd] the property (it is called MI property) in which the emission current Ie carries out a monotonous increment to the component electrical potential difference Vf, the emission current Ie is controllable by the component electrical potential difference Vf.

[0073] It depends for the bleedoff charge with which the anode electrode 54 (refer to drawing 4) is supplemented the 3rd on the time amount which impresses the component electrical potential difference Vf. That is, the amount of charges caught by the anode electrode 54 is controllable by the time amount which impresses the component electrical potential difference Vf.

[0074] While the emission current Ie has MI property to the component electrical potential difference Vf, the component current If may also have MI property to the component electrical potential difference Vf. The example of the property of such a surface conduction mold electron emission component is the property shown in (a) of drawing 5 . On the other hand, as shown in (b) of drawing 5 , the component current If may show voltage-controlled negative resistance characteristics (it is called a VCNR property) to the component electrical potential difference Vf. It is dependent on the process of a surface conduction mold electron emission component, the Measuring condition at the time of measurement, etc. whether which property is shown. However, the emission current Ie has MI property to the component electrical potential difference Vf also with the surface conduction mold electron emission component for which the component current If has a VCNR property to the component electrical potential difference Vf.

[0075] Because of the characteristic property of the surface conduction mold electron emission component by above this inventions, according to an input signal, the amount of emission electron can be easily controlled also by the electron source and image formation equipment which have arranged two or more components, and the application to the direction of many is possible.

[0076] Next, the electron source which has arranged two or more above-mentioned surface conduction mold electron emission components as an example of the electron source of this invention is described. First, the array method of a surface conduction mold electron emission component is explained.

[0077] As an array method of the surface conduction mold electron emission component in the electron source of this invention, the direction wiring of Y of n is installed through a layer insulation layer after the direction wiring of X of m besides ladder type arrangement which was stated by the term of a Prior art, and the arrangement method which connected the direction wiring of X and the direction wiring of Y to the component electrode of the couple of a surface conduction mold electron emission component, respectively is held. This is henceforth called passive-matrix arrangement. First, this passive-matrix arrangement is explained in full detail.

[0078] According to the fundamental property of the surface conduction mold electron emission component mentioned above, the emission electron in the surface conduction mold electron emission component by which passive-matrix arrangement was carried out is controllable by the peak value and pulse width of a pulse-like electrical potential difference which are impressed to the component inter-electrode which counters with the electrical potential difference exceeding a threshold electrical potential difference. On the other hand, an electron is hardly emitted below on a threshold electrical potential difference. Therefore, if the above-mentioned pulse-like electrical potential difference is suitably impressed to each component when many surface conduction mold electron emission components have been arranged, according to an input signal, a surface conduction mold electron emission component is chosen, the amount of electron emission can be controlled, the surface conduction mold electron emission component according to individual will be chosen only with simple matrix wiring, and actuation will become independently possible.

[0079] Passive-matrix arrangement is further explained based on drawing 6 based on such a principle about the configuration of the electron source of this passive-matrix arrangement that is an example of the electron source of this invention.

[0080] In drawing 6 , a substrate 1 is a glass plate which was already explained, and the number and the configuration of the surface conduction mold electron emission component 104 by this invention arranged on this substrate 1 are suitably set up according to an application.

[0081] The direction wiring 102 of X of m is the conductive metal which has the external terminals Dx1, Dx2, ..., Dxm, and was each formed by the vacuum deposition method, print processes, a spatter, etc. on the substrate 1. Moreover, an ingredient, thickness, and wiring width of face are set up so that an electrical potential difference may be supplied to many surface conduction mold electron emission components 104 almost uniformly.

[0082] Each, it has the external terminals Dy1, Dy2, ..., Dyn, and the direction wiring 103 of Y of n is created like the

direction wiring 102 of X.
[0083] A non-illustrated layer insulation layer is installed between the direction wiring 102 of X and the direction wiring 103 of Y of n of these m, it dissociates electrically, and matrix wiring is constituted. In addition, this m and n are both a forward integer.
[0084] SiO2 in which the non-illustrated layer insulation layer was formed by the vacuum deposition method, print processes, a spatter, etc. etc. -- it is -- it is formed in the whole surface or some of substrate 1 in which the direction wiring 102 of X was formed, in a desired configuration, and thickness, an ingredient, and a process are suitably set up so that the potential difference of the intersection of the direction wiring 102 of X and the direction wiring 103 of Y can be borne especially. The direction wiring 102 of X and the direction wiring 103 of Y are pulled out as an external terminal, respectively.
[0085] Furthermore, the component electrode (un-illustrating) with which the surface conduction mold electron emission component 104 counters is electrically connected by the direction wiring 102 of X of m, the direction wiring 103 of Y of n, and the connection 105 that consists of a conductive metal formed by the vacuum deposition method, print processes, a spatter, etc.
[0086] Here, even if m the direction wiring 102 of X, the direction wiring 103 of Y of n and connection 105, and the component electrode which counters have same some or all of the configuration element, you may differ, respectively and it is suitably chosen from the ingredient of the above-mentioned component electrode etc. It may be named a component electrode generically when wiring to these components electrode has a component electrode and the same ingredient. Moreover, the surface conduction mold electron emission component 104 may be formed in whichever on a substrate 1 or a non-illustrated layer insulation layer.
[0087] Moreover, although mentioned later in detail, in order to scan the line of the surface conduction mold electron emission component 104 arranged in the direction of X according to an input signal, a scan signal impression means by which it does not illustrate [which impresses a scan signal] is electrically connected to said direction wiring 102 of X.
[0088] On the other hand, in order to modulate each train of the train of the surface conduction mold electron emission component 104 arranged in the direction of Y according to an input signal, a modulating-signal generating means by which it does not illustrate [which impresses a modulating signal] is electrically connected to the direction wiring 103 of Y. Furthermore, the driver voltage impressed to each surface conduction mold electron emission component 104 is supplied as a difference electrical potential difference of the scan signal impressed to the surface conduction mold electron emission component 104 concerned, and a modulating signal.
[0089] Next, an example of the image formation equipment of this invention constituted using the electron source of the above passive-matrix arrangement is explained using drawing 7 - drawing 9 . In addition, drawing 8 is drawing showing a fluorescent screen 114, drawing 7 is the basic block diagram of a display panel 201, and it is [drawing 9 is the display panel 201 of drawing 8 , and] the block diagram showing an example of the actuation circuit for performing a television display according to the TV signal of NTSC system.
[0090] The substrate of an electron source with which 1 has arranged the surface conduction mold electron emission component as mentioned above in drawing 7 , The rear plate with which 111 fixed the substrate 1, the face plate with which, as for 116, the fluorescent screen 114 and the metal back 115 grade were formed in the inner surface of a glass substrate 113, It is a housing, and 112 applies frit glass etc. to the rear plate 111, a housing 112, and a face plate 116, out of atmospheric air or nitrogen, it is sealed by calcinating 10 minutes or more at 400-500 degrees C, and constitutes the envelope 118.
[0091] In drawing 7 , 102,103 is the direction wiring of X and the direction wiring of Y which were connected with the component electrodes 4 and 5 (refer to drawing 1) of the couple of the surface conduction mold electron emission component 104, and has the external terminal Dx1 Dxm and Dy1 thru/or Dyn, respectively.
[0092] The envelope 118 consists of a face plate 116, a housing 112, and a rear plate 111 like ****. However, when it is prepared in order to mainly reinforce the reinforcement of a substrate 1, and it has sufficient reinforcement by substrate 1 the very thing, the rear plate 111 of the rear plate 111 of another object is unnecessary, seals the direct housing 112 in a substrate 1, and may constitute an envelope 118 from a face plate 116, a housing 112, and a substrate 1. Moreover, it can also consider as the envelope 118 which has sufficient reinforcement to atmospheric pressure by installing further the base material which is not illustrated [which is called a SU **-sir between a face plate 116 and the rear plate 111].
[0093] In the case of monochrome, it consists only of a fluorescent substance 122, but in the case of the fluorescent screen 114 of a color, a fluorescent screen 114 is constituted from the black **** material 121 and fluorescent substance 122 which are called a black stripe (drawing 8 (a)) or a black matrix (drawing 8 (b)) by the array of a fluorescent substance 122. The objects in which a black stripe and a black matrix are prepared are it not being

conspicuous and carrying out color mixture etc. by distinguishing by different color between each fluorescent substance 122 in three primary colors which is needed in the case of color display with, and making the section black, and controlling lowering of the contrast by the outdoor daylight echo in a fluorescent screen 114. There is not only the ingredient that uses as a principal component the graphite usually well used as an ingredient of the black **** material 121 but conductivity, and other ingredients can also be used if transparency and echoes of light are few ingredients.
[0094] As an approach of applying a fluorescent substance 122 to a glass substrate 113, it is not based on monochrome and a color but a precipitation method and print processes are used.
[0095] Moreover, as shown in drawing 7 , the metal back 115 is usually formed in the inner surface side of a fluorescent screen 114. The metal back's 115 object is protection of the fluorescent substance 122 from the damage by the collision of the anion generated within acting as an electrode for impressing improving brightness and electron beam acceleration voltage and an envelope 118 etc. by carrying out specular reflection of the light by the side of an inner surface to a face plate 116 side among luminescence of a fluorescent substance 122 (refer to drawing 8). The metal back 115 performs data smoothing (usually called filming) of the inner surface side front face of a fluorescent screen 114 after production of a fluorescent screen 114, and it can produce by depositing aluminum with vacuum deposition etc. after that.
[0096] In order to raise the conductivity of a fluorescent screen 114 to a face plate 116 further, a transparent electrode (un-illustrating) may be prepared in the outside surface side of a fluorescent screen 114.
[0097] In case the above-mentioned sealing is performed, in order to have to make each color fluorescent substance 122 and the surface conduction mold electron emission component 104 correspond, in the case of a color, it is necessary to perform sufficient alignment.
[0098] The inside of an envelope 118 is closed, after exhausting through a non-illustrated exhaust pipe and reaching a predetermined degree of vacuum. Moreover, getter processing can also be performed in order to maintain the degree of vacuum after closure of an envelope 118. This is processing which heats the getter (un-illustrating) arranged to the position in an envelope 118, and forms the vacuum evaporationo film by resistance heating or high-frequency heating after closure, just before closing an envelope 118. Ba etc. is usually a principal component and a getter is for maintaining the degree of vacuum of torr by the absorption of this vacuum evaporationo film the 1x10 to 5th power, or the 1x10 to 7th power.
[0099] In addition, the closure direct front stirrup of an envelope 118 is usually performed for each production process of the surface conduction mold electron emission component after the foaming processing mentioned above after closure, and the content is as having mentioned above.
[0100] The above-mentioned display panel 201 can be driven in an actuation circuit as shown in drawing 9 . in addition, drawing 9 -- setting -- 201 -- a display panel and 202 -- for a shift register and 205, line memory and 206 are [a scanning circuit and 203 / a control circuit and 204 / a modulating-signal generator, and Vx and Va of a synchronizing signal separation circuit and 207] direct current voltage supplies.
[0101] As shown in drawing 9 , the display panel 201 is connected with the external electrical circuit through the external terminal Dx1 thru/or Dxm, the external terminal Dy1 or Dyn, and a secondary terminal Hv. Among this, the scan signal for carrying out one-line (every n elements) sequential actuation of the surface conduction mold electron emission elements by which matrix arrangement was carried out, and going is impressed to the letter of a matrix of the surface conduction mold electron emission component prepared in said display panel 201, i.e., a m line n train, at the external terminal Dx1 thru/or Dxm.
[0102] On the other hand, the modulating signal for controlling the output electron beam of each surface conduction mold electron emission component of one line chosen by said scan signal is impressed to a terminal Dy1 thru/or the external terminal Dyn. Moreover, the direct current voltage of 10kV is supplied to a secondary terminal Hv from direct current voltage supply Va. This is the acceleration voltage for giving sufficient energy exciting a fluorescent substance to the electron beam outputted from a surface conduction mold electron emission component.
[0103] A scanning circuit 202 equips the interior with m switching elements (the inside S1 of drawing 9 thru/or Sm show typically), and each switching elements S1-Sm choose the output voltage of the direct-current-voltage power source Vx, or either of 0V (grand level), and connect it to the external terminal Dx1 thru/or Dxm and an electric target of a display panel 201. Each switching elements S1-Sm can be easily constituted by combining the component which operates based on the control signal Tscan which a control circuit 203 outputs, and has a switching function like FET actually.
[0104] Said direct current voltage supply Vx in this example are set up so that a fixed electrical potential difference which the driver voltage impressed to the surface conduction mold electron emission component which is not scanned turns into below a threshold electrical potential difference may be outputted based on the property (threshold electrical

potential difference) of said surface conduction mold electron emission component.
[0105] A control circuit 203 has the work which adjusts actuation of each part so that a suitable display may be performed based on the picture signal inputted from the exterior. Based on the synchronizing signal Tsync sent from the synchronizing signal separation circuit 206 explained below, each control signal of Tscan, Tsft, and Tmry is generated to each part.
[0106] The synchronizing signal separation circuit 206 can be easily constituted, if a frequency-separation (filter) circuit is used from the TV signal of the NTSC system inputted from the outside as it is a circuit for separating a synchronizing signal component and a luminance-signal component and is known well. As for the synchronizing signal separated by the synchronizing signal separation circuit 206, this also consists of a Vertical Synchronizing signal and a Horizontal Synchronizing signal so that may also be known well. Here, it illustrates as an expedient top Tsync of explanation. On the other hand, the luminance-signal component of the image separated from said TV signal is illustrated with a DATA signal for convenience. This DATA signal is inputted into a shift register 204.
[0107] A shift register 204 is for carrying out serial/parallel conversion of said DATA signal by which a serial input is carried out serially for every line of an image, and operates based on the control signal Tsft sent from said control circuit 203. You may put it in another way as this control signal Tsft being the shift clock of a shift register 204. Moreover, the data for the image of one line by which serial/parallel conversion was carried out (it is equivalent to the actuation data for n elements of a surface conduction mold electron emission component) are outputted from said shift register 204 as n parallel signals of Id1 thru/or Idn.
[0108] The line memory 205 is storage only for need time amount to memorize the data for the image of one line, and memorizes the content of Id1 thru/or Idn suitably according to the control signal Tmry sent from a control circuit 203. The memorized content is outputted as Id'1 thru/or Id'n, and is inputted into the modulating-signal generator 207.
[0109] The modulating-signal generator 207 is a source of a signal for carrying out the actuation modulation of each of a surface conduction mold electron emission component appropriately according to each of said image data Id'1 thru/or Id'n, and the output signal is impressed to the surface conduction mold electron emission component in a display panel 201 through a terminal Dy1 thru/or Dyn.
[0110] As mentioned above, the surface conduction mold electron emission component has the clear threshold electrical potential difference in electron emission, and only when the electrical potential difference exceeding a threshold electrical potential difference is impressed, electron emission produces it. Moreover, to the electrical potential difference exceeding a threshold electrical potential difference, the emission current also changes and goes according to change of the applied voltage to a surface conduction mold electron emission component. Although the change degree of the emission current to the value and applied voltage of a threshold electrical potential difference may change by changing the ingredient of a surface conduction mold electron emission component, a configuration, and the manufacture approach, the following things can say anyway.
[0111] That is, when impressing a pulse-like electrical potential difference to a surface conduction mold electron emission component, for example, even if it impresses the electrical potential difference below a threshold electrical potential difference, electron emission is not produced, but in impressing the electrical potential difference exceeding a threshold electrical potential difference, it produces electron emission. It is possible in that case to control the reinforcement of the electron beam outputted by changing the peak value of an electrical-potential-difference pulse to the 1st. It is possible to control the total amount of the charge of the electron beam outputted to the 2nd by changing the width of face of an electrical-potential-difference pulse.
[0112] Therefore, as a method which modulates a surface conduction mold electron emission component according to an input signal, an electrical-potential-difference modulation technique and pulse width modulation are held. Although the electrical-potential-difference pulse of fixed die length is generated as a modulating-signal generator 207 when holding an electrical-potential-difference modulation technique, the circuit of the electrical-potential-difference modulation technique which can modulate the peak value of a pulse suitably according to the data inputted is used. Moreover, although the electrical-potential-difference pulse of fixed peak value is generated as a modulating-signal generator 207 when holding pulse width modulation, the circuit of the pulse width modulation which can modulate pulse width suitably according to the data inputted is used.
[0113] The thing or the thing of an analog signal type of a digital signal type is sufficient as a shift register 204 or the line memory 205, and serial/parallel conversion and storage of a picture signal just perform them at the rate of predetermined.
[0114] To use a digital signal type, it is necessary to digital-signal-ize the output signal DATA of the synchronizing signal separation circuit 206. This can be performed by forming an A/D converter in the output section of the synchronizing signal separation circuit 206.

[0115] Moreover, in relation to this, the circuits where the output signal of the line memory 205 is formed in the modulating-signal generator 207 by the digital signal or the analog signal differ a little.
[0116] Namely, what is necessary is just to add an amplifying circuit etc. to the modulating-signal generator 207 if needed using the D/A conversion circuit known well, for example with a digital signal in the case of an electrical-potential-difference modulation technique. Moreover, in the case of pulse width modulation, a digital signal can constitute the modulating-signal generator 207 from using the circuit which combined the comparator (comparator) which compares with the output value of said memory the output value of the counter (counter) which carries out counting of the wave number which a high-speed oscillator and an oscillator output, and a counter easily. Furthermore, the amplifier for amplifying the voltage of the modulating signal which a comparator outputs and by which Pulse Density Modulation was carried out even to the driver voltage of a surface conduction mold electron emission component if needed may be added.
[0117] On the other hand, in the case of an electrical-potential-difference modulation technique, a level shift circuit etc. may be added to the modulating-signal generator 207 if needed that what is necessary is just to use the amplifying circuit using the operational amplifier known well, for example with an analog signal. Moreover, the amplifier for amplifying the voltage even to the driver voltage of a surface conduction mold electron emission component if needed that what is necessary is just to use in the case of pulse width modulation (VCO) (for example, the voltage-controlled oscillator circuit known well) with an analog signal may be added.
[0118] The image formation equipment concerning this invention which has the above display panels 201 and an actuation circuit By impressing an electrical potential difference from Terminals Dx1-Dxm, and Dy1-Dyn Can make an electron emit from a required surface conduction mold electron emission component, and a secondary terminal Hv is led. The excitation and luminescence which impresses high tension to the metal back 115 or a transparent electrode (un-illustrating), accelerates an electron beam, and produces the accelerated electron beam by making it collide with a fluorescent screen 114 can perform a television display according to the TV signal of NTSC system.
[0119] In addition, the configuration explained above is suitably chosen so that it is an outline configuration required when obtaining the image formation equipment of this invention used for a display etc., for example, detailed parts, such as an ingredient of each part material, may not be restricted to the above-mentioned content and it may be suitable for the application of image formation equipment. Moreover, although NTSC system was held as an input signal, the image formation equipment of this invention may not be restricted to this, other methods, such as PAL and an SECAM system, are sufficient as it, and TV signal which consists of much scanning lines rather than these further, for example, the high definition TV method which makes MUSE the start, is sufficient as it.
[0120] Next, an example of the image formation equipment of this invention constituted using the electron source of the above-mentioned ladder type arrangement and this is explained using drawing 10 and drawing 11 .
[0121] In drawing 10 , ten 1 is prepared with common wiring whose 304 a substrate and 104 connect a surface conduction mold electron emission component, and connects the surface conduction mold electron emission component 104, and has the external terminals D1-D10 respectively.
[0122] Two or more surface conduction mold electron emission components 104 are arranged on the substrate 1 at juxtaposition. This is called a component line. And multi-line arrangement is carried out and this component line constitutes the electron source.
[0123] It is possible to drive each component line independently by impressing proper driver voltage between the common wiring 304 (for example, common wiring 304 of the external terminals D1 and D2) of each component line. Namely, what is necessary is to impress the electrical potential difference exceeding a threshold electrical potential difference to a component line to make it emit an electron beam, and just to make it impress the electrical potential difference below a threshold electrical potential difference to a component line to make it emit an electron beam. Impression of such driver voltage can perform the common wiring 304 304 of the external terminal D2 which adjoins each other, respectively, D3 and D4, D5 and D6, and D7, D8 and D9 which adjoins each other, respectively, i.e., common wiring, also as the same wiring of one about the common wiring D2-D9 located in each component space.
[0124] Drawing 11 is drawing showing the structure of the display panel 301 equipped with the electron source of the above-mentioned ladder type arrangement.
[0125] An external terminal for opening for a grid electrode to pass 302 in drawing 11 , and for an electron pass 303, and D1-Dm to impress an electrical potential difference to each surface conduction mold electron emission component, and G1-Gn are the external terminals connected to the grid electrode 302. Moreover, the common wiring 304 of each component space is formed on the substrate 1 as the same wiring of one.
[0126] In addition, the big difference from the display panel 201 using the electron source of the passive-matrix arrangement which the same sign as drawing 7 shows the same member in drawing 11 , and is shown in drawing 7 is

the point of having the grid electrode 302 between the substrate 1 and the face plate 116.
[0127] Between the substrate 1 and the face plate 116, the grid electrode 302 is formed as mentioned above. This grid electrode 302 can modulate the electron beam emitted from the surface conduction mold electron emission component 104, and in order to make the electrode of the shape of a stripe established by going direct with the component line of ladder type arrangement pass an electron beam, it is what formed the opening 303 circular one piece at a time corresponding to each surface conduction mold electron emission component 104.
[0128] Since much openings 303 are formed in the shape of a mesh so that the configuration or arrangement location of the grid electrode 302 may not necessarily be shown in drawing 11 , the grid electrode 302 may be formed a perimeter and near the surface conduction mold electron emission component 104.
[0129] The external terminals D1-Dm, and G1-Gn are connected to the non-illustrated actuation circuit. And by impressing the modulating signal for the image of one line to the train of the grid electrode 302 synchronizing with carrying out sequential actuation (scan) of the one every train of the component lines, and going, the exposure to the fluorescent screen 114 of each electron beam can be controlled, and it can display the image of one line at a time.
[0130] As mentioned above, even if the electron source of which this invention of passive-matrix arrangement and ladder type arrangement is used for the image formation equipment of this invention, it can be obtained, and image formation equipment suitable as indicating equipments, such as not only the indicating equipment of the television broadcasting mentioned above but a video conference system, a computer, etc., is obtained. Furthermore, it can use also as an aligner of the optical printer constituted from a photoconductor drum.
[0131]
[Example] Although a concrete example is given to below and this invention is explained to it in detail, this invention is not limited to these examples and also includes that by which the permutation and design change of each element within the limits by which the object of this invention is attained were made.
[0132] (Examples 1-7) The configuration of the surface conduction mold electron emission component of this example is the same as that of what is shown in drawing 1 , and explains the manufacture approach below based on production process drawing of drawing 2 .
[0133] a process -1 -- the sequential deposition of Ti with a thickness of 5 nanometers and the nickel with a thickness of 100 nanometers was carried out with the vacuum deposition method using the fully washed blue plate glass substrate 1. Patterning was performed by the photolithography method and the electrode for piezo electric crystals was formed (drawing 2 (a)).
[0134] The piezo electric crystal layer 6 was formed with the spatter or the spray method as a process -2, next each example using the ingredient shown in a table 1 (drawing 2 (a)).
[0135] The sequential deposition of Ti with a thickness of 5 nanometers and the nickel with a thickness of 100 nanometers was carried out with the process -3, next the vacuum deposition method. Patterning was performed by the photolithography method and the component electrodes 4 and 5 whose component electrode spacings L are 3 micrometers were formed (drawing 2 (b)).
[0136] After carrying out revolution spreading of a process -4, next the organic Pd complex (ccp4230 and product made from Okuno Pharmaceuticals) with the spinner and performing heating baking processing for 10 minutes at 300 degrees C, patterning was carried out to the predetermined configuration by the photolithography method, and the conductive film 3 was formed (drawing 2 (b)).
[0137] After having installed the substrate 1 which passed through the process-5 above-mentioned process in the vacuum housing 55 of the measurement assessment system of drawing 4 , exhausting with the vacuum pump and reaching the degree of vacuum of torr the 2x10 to 5th power, from the power source 51 for impressing the component electrical potential difference Vf, between the component electrode 4 and 5, the electrical potential difference was impressed, energization processing (foaming processing) was performed, and the electron emission section 2 was formed (drawing 2 (c)).
[0138] The piezo electric crystal layer under a process -6, next the crack part of the electron emission section 2 was removed by etching (drawing 2 (c)).
[0139] While installing process -7 substrate 1 in the vacuum housing 55 of the measurement assessment system of drawing 4 and impressing the component electrical potential difference Vf according to a power source 51 between the component electrode 4 and 5 first, 1kV - 10kV is impressed to the anode electrode 54 by the high voltage power supply 53. Ammeters 50 and 52 detected the component current If and the emission current Ie which flow at this time, the electrical potential difference of a power source 55 was controlled by the armature-voltage control means 56 based on this detection result, and the desired electrical potential difference was impressed to the piezo electric crystal layer 6.
[0140] The equivalence piezoelectric constant of the ingredient used for the piezo electric crystal layer 6 in each

example is as being shown in a table 1, for example, when a piezoelectric constant is the piezoelectric material of d31=10 pm/V, it can control crack width of face of the electron emission section 2 by applied voltage of about 1 V in about 100nm.

[0141] In the above actuation, activation which carried out point ** was also simultaneously performed with control of crack width of face.

[0142] In the above-mentioned actuation, when the electrical potential difference impressed to the piezo electric crystal layer 6 was controlled with the component electrical potential difference Vf fixed until the emission current Ie became a predetermined value, many components to which the property was equal were producible.

[0143]

[A table 1]

	圧電体層の材料	等価圧電定数 d_{31} ($\times 10^{-12}$m/V)
実施例 1	水晶	−2．0
実施例 2	チタン酸バリウム	−58
実施例 3	チタン酸鉛	−6．8
実施例 4	PZT−5A	−171
実施例 5	PZT−8	−97
実施例 6	ニオブ酸鉛	9
実施例 7	PVF_2	30

[0144] (Example 8) The electron source of passive-matrix arrangement as shown in drawing 6 , and image formation equipment as shown in drawing 7 were produced using the electron emission component of examples 1-7.

[0145] Manufacture of an electron source can be performed by extending the manufacture approach of the electron emission component of examples 1-7, and the detail is omitted.

[0146] Next, the example from which two or more conductive film produced as mentioned above constituted image formation equipment using the substrate 1 (refer to drawing 6) by which matrix wiring was carried out After fixing concrete point ** and the substrate 1 (refer to drawing 6) with which matrix wiring of two or more conductive film was carried out as mentioned above on the rear plate 111 with reference to drawing 7 and drawing 8 , To 4mm upper part of a substrate 1, a face plate 116 (a fluorescent screen 114 and the metal back 115 are formed and constituted by the inner surface of a glass substrate 113) is arranged through a housing 112. A face plate 116, housing Frit glass was applied to the joint of 112 and the rear plate 111, and it sealed by calcinating 10 minutes or more at 430 degrees C in atmospheric air. Moreover, frit glass also performed immobilization of the substrate 1 to the rear plate 111.

[0147] In the case of monochrome, it consisted only of a fluorescent substance 122, but in this example, the fluorescent substance 122 adopted the stripe configuration (drawing 8 (a)), and the fluorescent screen 114 formed the black stripe previously, applied each color fluorescent substance 122 to the gap section, and produced the fluorescent screen 114. The ingredient which uses as a principal component the graphite usually well used as an ingredient of a black stripe was used.

[0148] Slurry method was used as an approach of applying a fluorescent substance 122 to a glass substrate 113. Moreover, the metal back 115 was formed in the inner surface side of a fluorescent screen 114. The metal back 115 performed data smoothing (usually called filming) of the inner surface side front face of a fluorescent screen 114 after production of a fluorescent screen 114, and it produced by carrying out vacuum deposition of the aluminum after that.

[0149] Since the conductivity of a fluorescent screen 114 is further raised to a face plate 116, a transparent electrode (un-illustrating) may be prepared in the outside surface side of a fluorescent screen 114, but in this example, since conductivity sufficient in just the metal back 115 was acquired, it omitted.

[0150] When performing the above-mentioned sealing, in the case of the color, sufficient alignment was performed in order to have to make each color fluorescent substance 122 and the surface conduction mold electron emission component 104 correspond.

[0151] After performing sufficient exhaust air for the ambient atmosphere in the envelope 118 completed as mentioned above through an exhaust pipe (not shown), through the external terminal Dx1 Dxm and Dy1 thru/or Dyn, the electrical potential difference was impressed between the component electrode 4 and 5, and the electron emission section 2 was formed by carrying out foaming processing of the conductive film 3.

[0152] Moreover, the homogeneity of the electron emission characteristic of each component was able to be carried out like point ** by controlling the electrical potential difference impressed to the piezo electric crystal layer attached to each component, respectively.
[0153] Then, in order to exhaust the ambient atmosphere in an envelope 118 to the degree of vacuum of torr extent the 10 to 6.5th power with a vacuum pump through an exhaust pipe (not shown), to weld by heating a non-illustrated exhaust pipe with a gas burner, to close an envelope 118 and to maintain the degree of vacuum after closure further, getter processing was performed by the high-frequency-heating method.
[0154] In the image formation equipment of this invention completed as mentioned above, the external terminal Dx1 Dxm and Dy1 thru/or Dyn are led. While carrying out electron emission by impressing a scan signal and a modulating signal to the surface conduction mold electron emission component 104 from a signal generation means by which it does not illustrate, respectively Impressed the high voltage of several kV or more to the metal back 114 through the secondary terminal Hv, accelerated the electron beam, it was made to collide with a fluorescent screen 115, and the display of an image was obtained by making light excite and emit.
[0155]
[Effect of the Invention] As explained above, the electron emission component and electron source of this invention are controlling the electrical potential difference impressed to the piezo electric crystal layer 6, control the crack configuration of the electron emission section 2, and can control the electron emission characteristic. For this reason, it is very uniform and the component to which the electron emission characteristic was equal can be obtained.
[0156] Thereby, the electron source and image formation equipment of this invention turned into very high-definition equipment without brightness nonuniformity and image nonuniformity.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the rough block diagram showing the example of an embodiment of the electron emission component of this invention.
[Drawing 2] It is drawing for explaining the production process of the electron emission component of this invention.
[Drawing 3] It is drawing showing the example of a foaming wave.
[Drawing 4] It is the rough block diagram showing an example of the measurement assessment system of the electron emission component of this invention.
[Drawing 5] It is drawing showing the electrical property of the surface conduction mold electron emission component of this invention.
[Drawing 6] It is the rough block diagram of the electron source of this invention of passive-matrix arrangement.
[Drawing 7] It is the rough block diagram of the image formation equipment of this invention using the electron source of passive-matrix arrangement.
[Drawing 8] It is drawing showing the fluorescent screen in the display panel of drawing 7 .
[Drawing 9] It is drawing showing an example of an actuation circuit which drives the display panel of drawing 7 .
[Drawing 10] It is the rough top view of the electron source of ladder type arrangement.
[Drawing 11] It is the rough block diagram of the image formation equipment of this invention using the electron source of ladder type arrangement.
[Description of Notations]
1 Substrate
2 Electron Emission Section
3 Conductive Film
4 Five Component electrode
6 Piezo Electric Crystal Layer
7 Electrode for Piezo Electric Crystals
50 Ammeter for Measuring Component Current If
51 Power Source
52 Ammeter for Measuring Emission Current Ie
53 High Voltage Power Supply
54 Anode Electrode
55 Power Source
56 Armature-voltage Control Means
57 Vacuum Devices
58 Exhaust Air Pump
102 The Direction Wiring of X
103 The Direction Wiring of Y
104 Surface Conduction Mold Electron Emission Component
105 Connection
111 Rear Plate
112 Housing
113 Glass Substrate
114 Fluorescent Screen
115 Metal Back

116 Face Plate
118 Envelope
121 Black **** Material
122 Fluorescent Substance
123 EV Terminal
201 Display Panel
202 Scanning Circuit
203 Control Circuit
204 Shift Register
205 Line Memory
206 Synchronizing Signal Separation Circuit
207 Modulating-Signal Generator
301 Display Panel
302 Grid Electrode
303 Opening
304 Common Wiring

[Translation done.]

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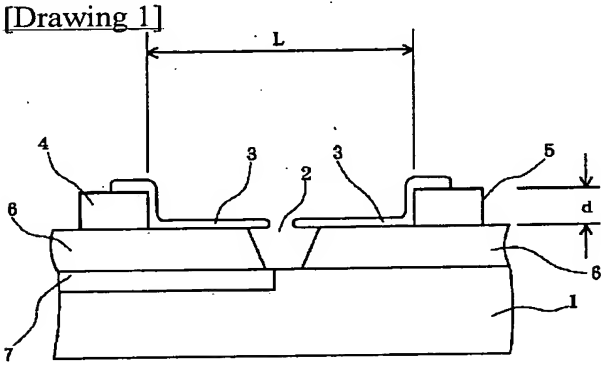
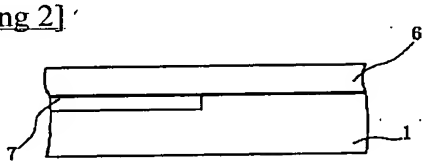
DRAWINGS

[Drawing 1]



[Drawing 2]

(a)



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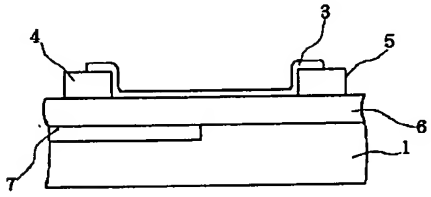
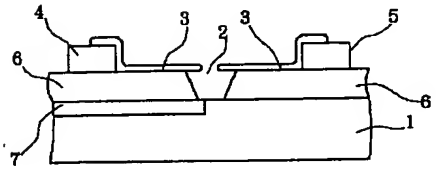
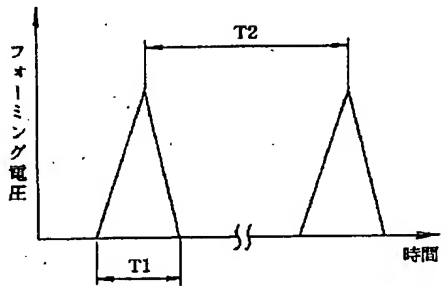


(c)



[Drawing 3]

(a)



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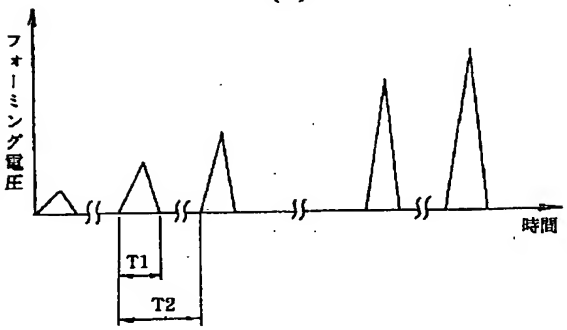
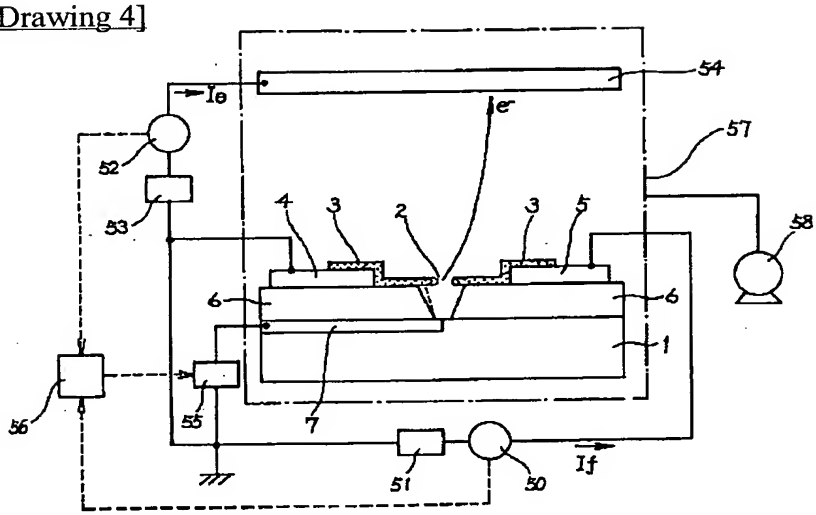
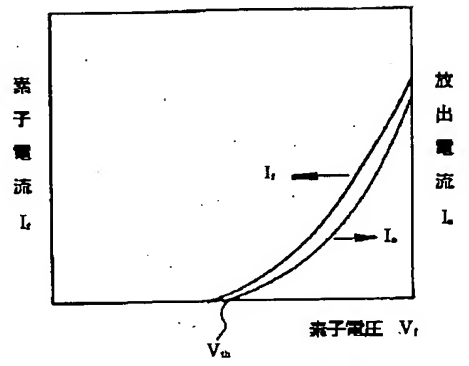


[Drawing 4]



[Drawing 5]

(a)



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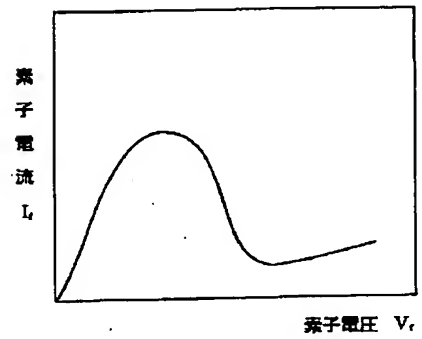
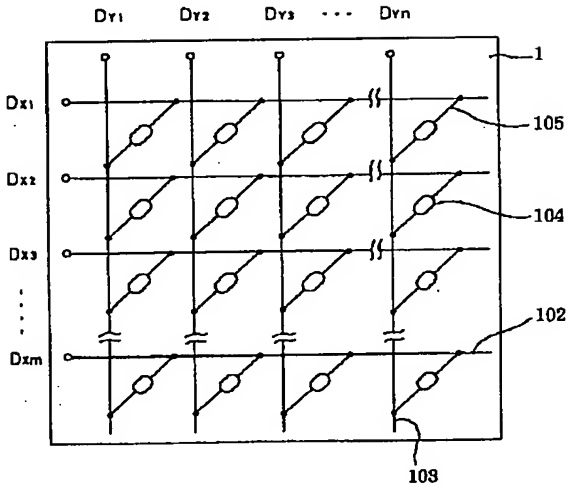
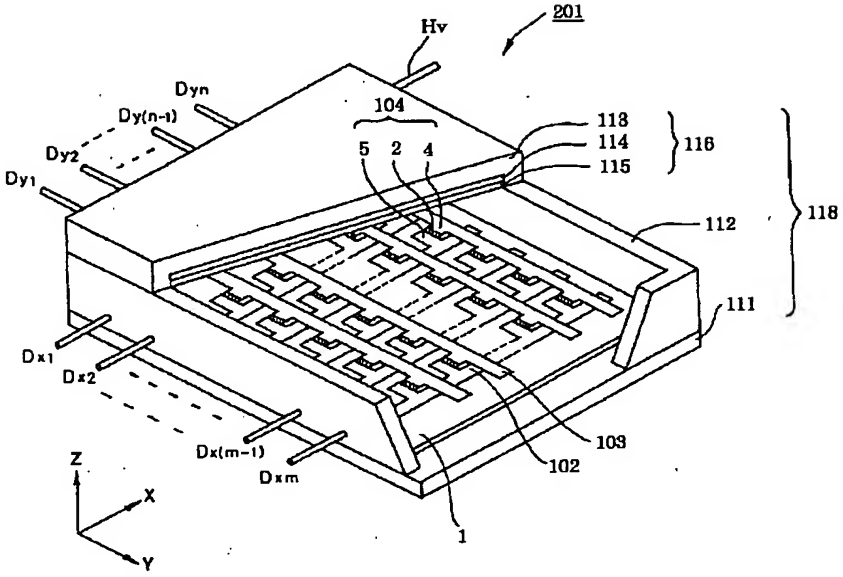


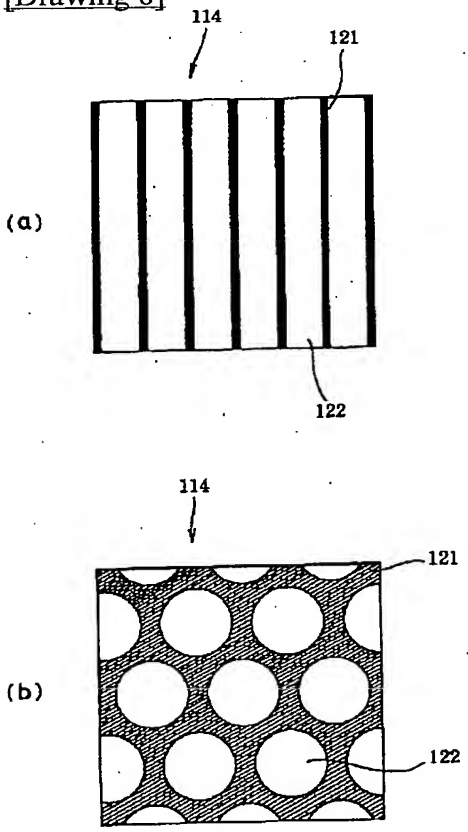
[Drawing 6]



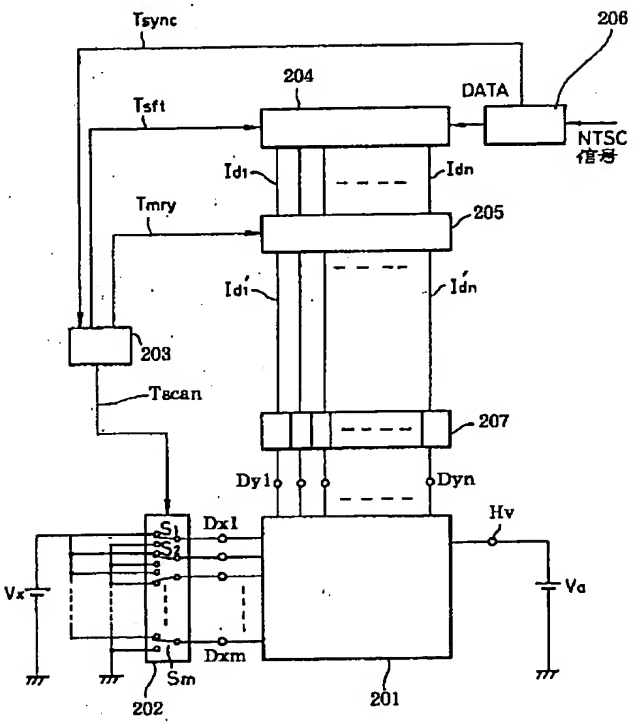
[Drawing 7]



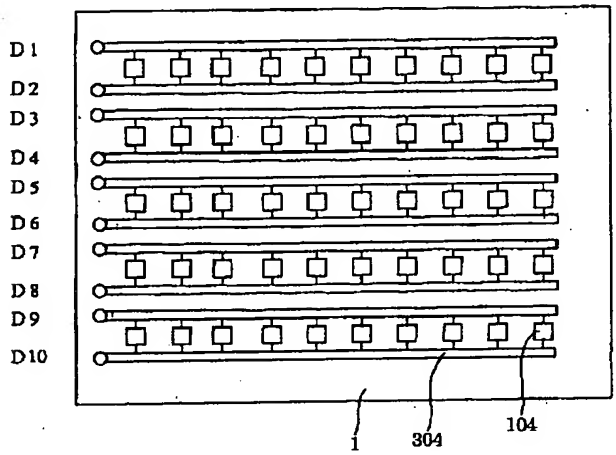
[Drawing 8]



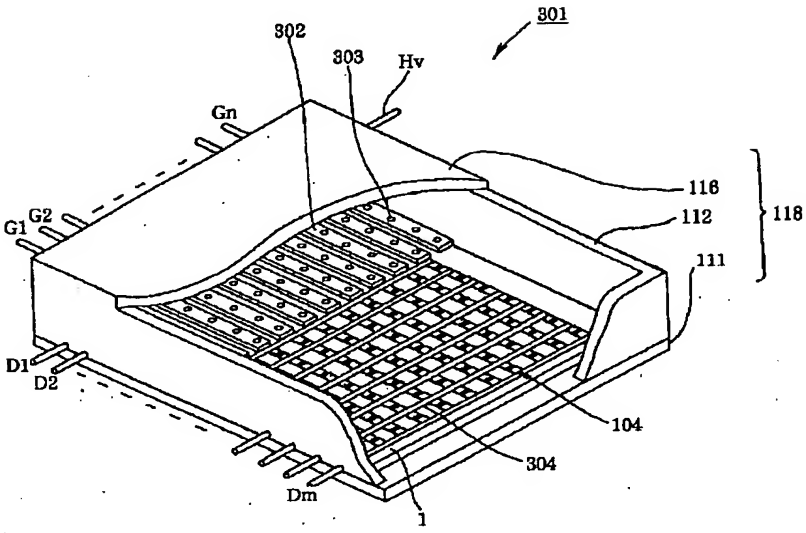
[Drawing 9]



[Drawing 10]



[Drawing 11]



[Translation done.]